UPDATE TO THE BIOLOGICAL EVALUATION SUBMITTED APRIL 17 AND AUGUST 6, 2008, REGARDING EPA ACTION ON WASHINGTON'S MARINE FINFISH REARING FACILITY PROVISION CONTAINED IN THE SEDIMENT MANAGEMENT STANDARDS

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PREFACE

In the Biological Evaluation of April 17, 2008 and supplement of August 6, 2008 (2008 BE),[1] EPA concluded that the approval of certain new and revised water quality standards in WAC 173-204 were likely to adversely affect listed fish species or marine mammals since the effects of such approval would be insignificant. The 2008 BE made the following findings:

- NOAA technical memoranda[2] indicate beneficial effects and low potential for negative effects.
- The designated uses of Puget Sound are protected.
- Netpen facilities have an insignificant impact on aquatic life in Puget Sound.
- The existing regulatory framework for netpens provides protection to surrounding habitat and other species.
- The effects on the benthic community are accounted for and monitored.
- The closure procedures of netpen facilities ensure the aquatic environment is restored to baseline levels.
- The indirect effects of netpen facilities carry a low risk.

In accordance with the April 28, 2010 Order of the U.S. District Court for the Western District of Washington, EPA has reconsidered whether approval of the new and revised water quality standards in WAC 173-204 may affect listed fish species or marine mammals, or their critical habitat. Along with the data in the original 2008 BE, and other updates to its information and analysis, EPA reviewed the following recovery plans:

> 1. National Marine Fisheries Service. 2007. Puget Sound Salmon Recovery Plan. Shared Strategy for Puget Sound adopted by National Marine Fisheries Service. Volumes I and II.[3]
>
> 2. National Marine Fisheries Service. 2008. Recovery Plan for Southern Resident Killer Whales *(Orcinus orca)*. National Marine Fisheries Service, Northwest Region, Seattle, Washington.[4]

The Puget Sound Salmon Recovery Plan (for chinook salmon, chum salmon and bull trout) and the Recovery Plan for Southern Resident Killer Whales offer only a limited discussion of the impact of netpens on these species. The primary potential threats from

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[1] U.S. EPA Region 10. *Biological Evaluation of Washington's Marine Finfish Rearing Facility Provision Contained in the Sediment Management Standards.* Prepared for U.S. Fish & Wildlife Service and National Marine Fisheries Service. April 17, 2008. Supplemented August 6, 2008.

[2] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001. Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002. Rensel, J.E. and J.R.M. Forster. Prepared for NOAA National Marine Fisheries Service. NOAA Award # NA04OAR4170130. July 22, 2007.

[3] Available online at: http://www.nwr.noaa.gov/Salmon-Recovery-Planning/Recovery-Domains/Puget-Sound/PS-Recovery-Plan.cfm

[4] Available online at: http://www.nwr.noaa.gov/Marine-Mammals/Whales-Dolphins-Porpoise/Killer-Whales/ESA-Status/upload/SRKW-Recov-Plan.pdf

netpen operations highlighted in these limited discussions are water quality impacts and escape of farmed salmon. The recovery plans do not make any findings that current netpen operations cause impacts to water quality or result in farmed salmon escape; rather, the plans speculate about the *potential* effects of poor aquaculture practices on listed species.

Following a review of the recovery plans, EPA determined that although netpen operation in accordance with WAC 173-204 may affect ESA listed species or their critical habitat, the effect is NLAA the three species of salmonids and the southern resident killer whale. For each instance that netpen operations is mentioned in the recovery plans, the rationale for these NLAA determinations is provided below.

For the reasons detailed in this document, EPA is reaffirming the NLAA determinations contained in the 2008 BE. EPA is also reaffirming its no effect determinations that were made in the 2008 BE.

EPA has also provided an analysis for the three newly listed species of rockfish in Puget Sound: boccacio, canary, and yelloweye rockfish. EPA has determined its action is NLAA these species or their critical habitat.

1. BACKGROUND

In 1991, EPA approved Washington's Sediment Management Standards (SMS), WAC 173-204. Washington's SMS address three primary areas: (1) standards for assessing the nature and extent of sediment contamination, (2) procedures for cleanup of historical sediment contamination, and (3) procedures for preventing future sediment contamination from discharges.[5]

On June 3, 1996, the Washington State Department of Ecology (Ecology) submitted revisions to WAC 173-204, which included minor revisions to the sediment testing methodology provisions and a new section for marine finfish rearing facilities, WAC-173-204-412. These revisions were subject to the Alaska Rule since they were adopted by Washington prior to May 30, 2000 and EPA took no action prior to that date. Therefore, Washington's 1996 sediment management standard revisions went into effect for Clean Water Act purposes as soon as they were effective under state law since they were submitted to EPA for review prior to May 30, 2000, according to 40 CFR 131.21(c)(1).

The addition of the marine finfish fearing facility section exempts netpen facilities in Puget Sound from portions of Washington's sediment management standards. The section also states that sediment quality compliance and monitoring requirements of netpen facilities are addressed through NPDES permitting. The section allows for a sediment impact zone within 100 feet from the outer edge of netpen facilities; consequently, such facilities are exempt from: marine sediment quality standards, sediment impact zone maximum criteria, and sediment impact zone standards. The section also allows Ecology to authorize sediment impact zones beyond 100 feet via NPDES permits or administrative actions, subject to increased monitoring. There are no exemptions from meeting Washington's water quality standards for netpen facilities.

Currently, there are eight Atlantic salmon netpen facilities in Puget Sound, which produce over 10 million pounds of salmon annually.[6] Ecology issued NPDES permits for all eight facilities. The Washington State Department of Natural Resources (WDNR) issued a site license for each facility; and the Washington Department of Fish and Wildlife (WDFW) regulates disease control and escape management at each facility.

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[5] Washington State Department of Ecology. "Sediment Cleanup Status Report." June 2005. Publication Number 05-09-092. <http://www.ecy.wa.gov/pubs/0509092.pdf>

[6] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007. < http://www.ecy.wa.gov/programs/wq/permits/northwest_permits.html>

2. DESCRIPTION OF THE ACTION

This Biological Evaluation (BE) is limited to those new and revised water quality standards which can affect aquatic life. Additionally, the analysis of the effects of the new and revised water quality standards provisions assumes that ESA-listed species and their habitat are exposed to waters meeting Washington's water quality standards. The following is a list of the new provisions which could affect aquatic life, and will be addressed specifically in this BE.

- WAC 173-204-200 (13): Definition of "Marine finfish rearing facilities."
- *WAC 173-204-315(1)(b)(ii)*
- *WAC 173-204-315(2)(b)*
- *WAC 173-204-315 (2)(d)*
- *WAC 173-204-320 (3)(d)*
- WAC 173-204-412 (2): Applicability of marine finfish rearing facilities.
- WAC 173-204-412 (3): Sediment monitoring requirements of marine finfish rearing facilities.
- WAC 173-204-412 (4): Sediment impact zones for marine finfish rearing facilities.
- *WAC 173-204-420 (3)(c)(iv)*
- *WAC 173-204-520 (3)(d)(iv)*

The definition of marine finfish rearing facilities is evaluated in the context of the SMS. Washington revised several other provisions in their SMS, but those provisions are not part of EPA's proposed action or this consultation because they (1) are a non-substantive or formatting change, (2) are a minor editorial change that does not alter the water quality standards that EPA previously approved, or (3) are not a water quality standard which does not require EPA action.

Notes:

(A) The entire new language of the "marine finfish rearing facility" provision, WAC 173-204-412, is included in *Appendix 11.A.*

(B) WAC 173-204-200 (13) is a new definition for "marine finfish rearing facilities" as follows:

> "Marine finfish rearing facilities" shall mean those private and public facilities located within state waters where finfish are fed, nurtured, held, maintained, or reared to reach the size of release or for market sale.

(C) Several revisions to WAC 173-204 (in italics above) relate to sediment testing methodology. They were described in EPA's August 6, 2008 supplement to the 2008 BE. EPA reevaluated its conclusions in the August 6, 2008 supplement based upon any new information and has not modified these conclusions since the provisions relate only to sediment testing methodology. The changes to these provisions are provided in *Appendix 11.B.* EPA's analysis of these revisions is provided in Section 9 of this BE.

3. DESCRIPTION OF THE ACTION AREA

The sediment management standards for marine finfish rearing facilities are applicable to all eight Atlantic salmon rearing facilities in Puget Sound. Pacific salmon hatcheries are not evaluated in this Biological Evaluation since their primary function is to sustain populations of Pacific salmon. EPA's approval action does not apply to, and thus the action area does not include, any waters within Indian Country (i.e., Native American reservations, Indian communities, and trust lands).

Puget Sound is defined in the SMS in WAC-173-204-200(20): "Puget Sound basin" or "Puget Sound" means: (a) Puget Sound south of Admiralty Inlet, including Hood Canal and Saratoga Passage; (b) The waters north to the Canadian border, including portions of the Strait of Georgia; (c) The Strait of Juan de Fuca south of the Canadian border; and (d) All the lands draining into these waters as mapped in water resources inventory areas numbers 1 through 19, set forth in water resources management program established pursuant to the Water Resources Act of 1971, chapter 173-500 WAC.

Puget Sound contains 2,800 square miles of inland waters and 2,500 miles of shoreline. The Sound is composed of underwater valleys and ridges and has an average depth of 450 feet. Puget Sound is a partially enclosed estuary where saltwater mixes with freshwater from the surrounding watersheds. Ten main rivers drain into Puget Sound making up 85% of the basin's annual surface water runoff: the Nooksack, Skagit, Snohomish, Stillaguamish, Cedar/Lake Washington Canal, Green/Duwamish, Puyallup, Nisqually, Skokomish and Elwha.

The Puget Sound Action Team (PSAT) describes the basins of Puget Sound as follows: "A relatively shallow sill at Admiralty Inlet separates the waters of the Strait of Juan de Fuca from the waters of Puget Sound proper. South of Admiralty Inlet, Puget Sound proper consists of four interconnected basins. The largest and deepest of these, the Main Basin, consists of two sub-basins and extends some 60 miles from Admiralty Inlet to the Tacoma Narrows. Around the Tacoma Narrows, a shallow sill separates the Main Basin from the Southern Basin. To the north and east of the Main Basin (but not separated by a sill) is the Whidbey Basin. This basin is located to the east of Whidbey Island and includes the waters of Possession Sound, Port Susan, Saratoga Passage and Skagit Bay. The smallest of the four basins, in terms of area, is the Hood Canal Basin on the western side of the Sound. This long, narrow channel branches from the Main Basin south of Admiralty Inlet and extends about 80 miles south, between the Olympic Mountains and the Kitsap Peninsula." The nearshore habitat of Puget Sound encompasses the tidal and shallow subtidal areas close to the shoreline. Sunlight and vegetation are defining characteristic of nearshore habitat which differs from the deeper habitats which support benthic communities.[7]

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[7] Section on Puget Sound from Puget Sound Action Team. Definition of Puget Sound. Accessed online March 7, 2008. <http://www.psat.wa.gov/About_Sound/Define.htm>

4. SPECIES STATUS AND LIFE HISTORY

The complete list of the federally listed, threatened and endangered species under the jurisdiction of NOAA that are known or suspected to occur in Washington State are listed in the *Table 3-1* and *Table 3-2*. This list was obtained from the USFWS Threatened and Endangered Species System (TESS).[8]

Table 3-1: NOAA listed fish species known or suspected to occur in Washington.

Status	Salmonid Species – Evolutionarily Significant Units
Chinook Salmon (Oncorhynchus tshawytscha)	
T	Puget Sound
T	Snake River Fall Run
T	Lower Columbia River
E	Upper Columbia River Spring Run
T	Snake River Spring/Summer Run
Chum Salmon (Oncorhynchus keta)	
T	Columbia River
T	Hood Canal Summer Run
Coho Salmon (Oncorhynchus kisutch)	
T	Lower Columbia River*
Sockeye Salmon (Oncorhynchus nerka)	
T	Ozette Lake
Steelhead (Oncorhynchus mykiss)	
T	Puget Sound
T	Snake River Basin
T	Lower Columbia River
T	Upper Columbia River Basin
T	Middle Columbia River*
E	Bocaccio *(Sebastes paucispinis)*
T	Canary Rockfish *(Sebastes pinniger)*
T	Yelloweye Rockfish *(Sebastes ruberrimus)*

***** According to the USFWS TESS website this species is listed for the state but does not occur in the state.

Table 3-2: Federally listed non-fish species known or suspected to occur in Washington.

Status	Non-fish Species
Marine Mammals	
E	Humpback Whale (*Megaptera novaeagliae*)
E	Killer Whale, southern resident (*Orcinus orca*)
T	Southern Sea Otter (*Enhydra lutris neries*)*
T	Steller Sea Lion, eastern population (*Eumetpoias jubatus*)**
Marine Turtles	
T	Green Sea Turtle (*Chelonia mydas*)
E	Leatherback Sea Turtle (*Dermochelys coriacea*)

***** According to the USFWS TESS website this species is listed for the state but does not occur in the state.
** Western population is also listed but does not occur in the state.

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[8] U.S Fish and Wildlife Service. USFWS Threatened and Endangered Species System (TESS). Washington State. Accessed online August 17, 2010. <http://ecos.fws.gov/tess_public/StateListingAndOccurrence.do?state=WA>

4.A. SPECIES ASSESSED FOR EFFECTS

The primary actions that are evaluated in this Biological Evaluation are the changes to provisions of Washington's sediment management standards regarding benthic communities by marine finfish rearing facilities in Puget Sound. Thus, the species that could be affected by these actions, either directly or indirectly must have at least some portion of their range within the Puget Sound aquatic system. For this reason, the following species are considered to not be affected by the actions that will be evaluated in this BE.

The following **fish species** do not use aquatic habitats in Puget Sound during any portion of their life history, and therefore, receive a **NO EFFECT** determination and will not be addressed further in this BE:

Chinook Salmon (Oncorhynchus tshawytscha)

- Snake River Fall Run
- Lower Columbia River
- Upper Columbia River Spring Run
- Snake River Spring/Summer Run

Chum Salmon (Oncorhynchus keta)

- Columbia River

Coho Salmon (Oncorhynchus kisutch)

- Lower Columbia River (does not occur in state)

Sockeye Salmon (Oncorhynchus nerka)

- Ozette Lake

Steelhead (Oncorhynchus mykiss)

- Snake River Basin
- Lower Columbia River
- Upper Columbia River Basin
- Middle Columbia River (does not occur in state)

There are two listed species, noted in *Table 3-2*, which may possibly occur in Washington but have not been document to occur: **Southern Sea Otter and Steller Sea Lion (western population).** Since these species are not known to occur in Washington during any portion of their life history, the actions described in this BE will have **NO EFFECT** and will not be addressed further in this BE.

The **two turtle species**, leatherback sea turtles and green sea turtles are distributed in marine waters.[9] They are rarely found off Washington's coast and neither species nests on Washington's coast. Since these turtle species do not inhabit Puget Sound or nest on the shores of Puget Sound, they will not be affected by sediment quality standards and the quality of benthic communities in Puget Sound. Therefore, these actions will have **NO EFFECT** on the turtle species.

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[9] NOAA Fisheries. Office of Protected Resources. Leatherback Turtle Information webpage. Accessed online March 5, 2008. <http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm>

This BE will assess the effects of the proposed action to four salmonid evolutionarily significant units (ESUs) and three marine mammals that occur on the Federal Threatened and Endangered species list and may potentially be affected by this action. *Table 3-3* lists these species, their current status, and the Federal Register (FR) final rule notice for each species. *Table 3-4* provides the FR final rule notice for critical habitat designation for each of these species. Maps of the existing netpen facilities in Puget Sound and the designated critical habitat for the species assessed in this BE can be found in *Appendix 11.C*.

Table 3-3: Status of ESA-listed species assessed in this BE.

Species	ESU/DPS/Population	Present Status	FR Notice of Listing	
Chinook Salmon (*Oncorhynchus tshawytscha*)	Puget Sound ESU	Threatened	64 FR 14308	3/24/99
Chum Salmon (*Oncorhynchus keta*)	Hood Canal summer-run ESU	Threatened	64 FR 14528	3/25/99
Steelhead (*Oncorhynchus mykiss*)	Puget Sound, DPS	Threatened	72 FR 26722	5/11/07
Steller Sea Lion (*Eumetpoias jubatus*)	Pacific Coast, eastern pop.	Threatened	N/A	N/A
Humpback Whale (*Megaptera novaeangliae*)	Pacific Coast	Endangered	35 FR 8491	6/2/70
Killer Whale (*Orinus orca*)	Southern Resident, DPS	Endangered	70 FR 69903 72 FR 16284 (update)	11/18/05 4/4/07
Bocaccio (*Sebastes paucispinis*)	N/A	Endangered	75 FR 22276	4/28/10
Canary Rockfish (*Sebastes pinniger*)	N/A	Threatened	75 FR 22276	4/28/10
Yelloweye Rockfish (*Sebastes ruberrimus*)	N/A	Threatened	75 FR 22276	4/28/10

Table 3-4 Critical Habitat Designations of ESA-listed species assessed in this BE.

Species	ESU/DPS/Population	Present Status	FR Notice of Critical Habitat	
Chinook Salmon (*Oncorhynchus tshawytscha*)	Puget Sound ESU	Final Rule	70 FR 52630	9/2/05
Chum Salmon (*Oncorhynchus keta*)	Hood Canal summer-run ESU	Final Rule	70 FR 52630	9/2/05
Steelhead (*Oncorhynchus mykiss*)	Puget Sound, DPS	Under development	N/A	N/A
Steller Sea Lion (*Eumetpoias jubatus*)	Pacific Coast, eastern pop.	Not assigned in Washington	N/A	N/A
Humpback Whale (*Megaptera novaeangliae*)	Pacific Coast	Not assigned	N/A	N/A
Killer Whale (*Orinus orca*)	Southern Resident, DPS	Final Rule	50 CFR 226	11/29/06

Bocaccio (*Sebastes paucispinis*)	n/a	Not assigned	N/A	N/A
Canary Rockfish (*Sebastes pinniger*)	n/a	Not assigned	N/A	N/A
Yelloweye Rockfish (*Sebastes ruberrimus*)	n/a	Not assigned	N/A	N/A

4.B. LIFE HISTORY OF FISH SPECIES ASSESSED[10]

This section provides status and life history information for the four salmonid species and three rockfish species listed under the Endangered Species Act that are assessed in this BE.

4.B.1. Chinook salmon

Chinook salmon are easily distinguished from other *Oncorhynchus* species by their large size. Adults weighing over 120 pounds have been caught in North American waters. Chinook salmon are very similar to coho salmon in appearance while at sea (blue-green back with silver flanks), except for their large size, small black spots on both lobes of the tail, and black pigment along the base of the teeth. Chinook salmon are anadromous and semelparous. This means that as adults, they migrate from a marine environment into the freshwater streams and rivers of their birth (anadromous) where they spawn and die (semelparous). Adult female Chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth and velocity. Redds will vary widely in size and in location within the stream or river. The adult female Chinook may deposit eggs in four to five "nesting pockets" within a single redd. After laying eggs in a redd, adult Chinook will guard the redd from four to twenty-five days before dying. Chinook salmon eggs will hatch, depending upon water temperatures, between 90 to 150 days after deposition. Sufficient intergravel dissolved oxygen levels during the incubation period are critical to development of salmon eggs. Stream flow, gravel quality, and silt load all significantly influence the survival of developing Chinook salmon eggs as they influence intergravel dissolved oxygen levels. Juvenile Chinook may spend from three months to two years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature.

Among Chinook salmon two distinct races have evolved. One race, described as a "stream-type" Chinook, is found most commonly in headwater streams. Stream-type Chinook salmon have a longer freshwater residency, and undertake extensive offshore migrations before returning to their natal streams in the spring or summer months. The second race is called the "ocean-type" Chinook, which is commonly found in coastal streams in North America. Ocean-type Chinook typically migrate to sea within the first

[10] Life History information for the salmonid species and marine mammals in this section is from the Washington BE for the 2003/2006 WQS Revisions, April 10, 2007. Please see that document for more information on the references cited within this section. The sources cited in this section are not included in the Reference section of this BE.

three months of emergence, but they may spend up to a year in freshwater prior to emigration. They also spend their ocean life in coastal waters. Ocean-type Chinook salmon return to their natal streams or rivers as spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. The difference between these life history types is also physical, with both genetic and morphological foundations.

Juvenile stream- and ocean-type Chinook salmon have adapted to different ecological niches. Ocean-type Chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. The brackish water areas in estuaries also moderate physiological stress during parr-smolt transition. The development of the ocean-type life history strategy may have been a response to the limited carrying capacity of smaller stream systems and glacially scoured, unproductive, watersheds, or a means of avoiding the impact of seasonal floods in the lower portion of may watersheds.

Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of sub-yearling smolts (FR 63 11482, Montgomery et al. 1999). At the time of saltwater entry, stream-type (yearling) smolts are much larger, averaging 73-134 mm depending on the river system, than their ocean-type (sub-yearling) counterparts, and therefore, are able to move offshore relatively quickly.

Coast-wide, Chinook salmon remain at sea for one to six years (more common, two to four years), with the exception of a small proportion of yearling males, called jack salmon, which mature in freshwater or return after two or three months in salt water. Ocean- and stream-type Chinook salmon in coastal and mid-ocean fisheries likely have divergent migratory routes. Ocean-type Chinook salmon tend to migrate along the coast, while stream-type Chinook salmon are found far from the coast in the central North Pacific. Differences in the ocean distribution of specific stocks may be indicative of resource partitioning and may be important to the success of the species as a whole.

There is a significant genetic influence to the freshwater component of the returning adult migratory process. A number of studies show that Chinook salmon return to their natal streams with a high degree of fidelity. Salmon may have evolved this trait as a method of ensuring an adequate incubation and rearing habitat. It also provides a mechanism for reproductive isolation and local adaptation. Conversely, returning to a stream other than that of one's origin is important in colonizing new areas and responding to unfavorable or perturbed conditions at the natal stream.

Chinook salmon stocks exhibit considerable variability in size and age of maturation, and at least some portion of this variation is genetically determined. The relationship between size and length of migration may also reflect the earlier timing of river entry and the cessation of feeding for Chinook salmon stocks that migrate to the upper reaches of river systems. Body size, which is correlated with age, may be an important factor in migration and redd construction success. Under high density conditions on the spawning ground, natural selection may produce stocks with exceptionally large-sized returning adults.

Temporal "runs" or modes in the migration of Chinook salmon from the ocean to freshwater are well known (Wydoski and Whitney 2003). Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. Seasonal "runs" (i.e., spring, summer, fall, or winter) have been identified on the basis of when adult Chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual spawning. The timing of egg deposition must occur to ensure that fry emerge during the following spring when the river or estuary productivity is sufficient for juvenile survival and growth.

Pathogen resistance is another locally adapted trait. Chinook salmon from the Columbia River drainage were less susceptible to *Ceratomyxa shasta*, an endemic pathogen, then stocks from coastal rivers where the disease is not know to occur (FR 63 11482). Alaskan and Columbia River stocks of Chinook salmon exhibit different levels of susceptibility to the infectious hematopoietic necrosis virus (IHNV).

The preferred temperature range for Chinook salmon has been variously described as 12.2-13.9 degrees Celsius. (Brett 1952), 10-15.6 degrees Celsius. (Burrows, 1963), or 13-18 degrees Celsius. Temperatures for optimal egg incubation are 5.0-14.4 degrees Celsius. (Bell, 1984). The upper lethal temperature limit is 25.1 degrees Celsius. (Brett, 1952), but may be lower depending on other water quality factors (Ebel et al. 1971). Variability in temperature tolerance between populations is likely due to selection for local conditions; however, there is little information on the genetic basis of this trait.

The EPA (1986) recommends 8.0 mg/L intergravel DO for successful salmonid egg incubation. Freshwater juveniles avoid water with dissolved oxygen concentrations below 4.5 mg/l at 20 degrees Celsius. (Whitmore et al. 1960). Migrating adults will pass through water with dissolved oxygen levels as low as 3.5-4.0 mg/l (Alabaster 1988, 1989).

Puget Sound Chinook salmon

Geographic Boundaries and Spatial Distribution

The boundaries of this salmon ESU correspond with the Puget Lowland Ecoregion. This ESU encompasses all runs of Chinook salmon in the Puget Sound region from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula, including Hood Canal. Chinook salmon in this area all exhibit an ocean-type life history. Although some spring-run Chinook salmon populations in the Puget Sound ESU have a high proportion of yearling smolt emigrants, the proportion varies substantially from year to year and appears to be environmentally mediated rather than genetically determined. Puget Sound stocks all tend to mature at ages 3 and 4 and exhibit similar, coastally-oriented, ocean migration patterns (Meyers et al.1998).

Hatchery fish are known to spawn in the wild in the Elwha and Dungeness river basins and are not considered discrete stocks from the wild fish (WDFW and WWTIT 1994). Adult Chinook begin to enter the Elwha River in June and continue through early October. The timing for entry into the Dungeness is unknown. Spawning in both rivers takes place between August and October (WDFW and WWTIT 1994). Out-migration of Chinook smolts in the Elwha and Dungeness basins occurs between March and mid-July (Williams et al. 1975).

Critical Habitat

On April 30, 2002, the US District Court for the District of Columbia approved a NMFS consent decree withdrawing a February 2000 critical-habitat designation for this and 18 other evolutionary significant units (ESUs) (NMFS 2002). Critical habitat consists of the water, substrate, and the adjacent riparian zone of accessible estuarine and riverine reaches. The February 2000 critical-habitat designation included Puget Sound marine areas, including the south sound, Hood Canal, and north sound to the international boundary at the outer extent of the Strait of Georgia, Haro Strait, and the Strait of Juan de Fuca to a straight line extending north from the west end of Freshwater Bay, inclusive. Critical habitat designation for this ESU was finalized 09/02/05 (70 FR 52630).

Historical Information

Chinook salmon were abundant in Washington State near the turn of the century, when estimates based on peak cannery pack suggested peak runs of near one million fish in the Oregon Coast, Washington Coast, and Puget Sound ESUs. However, Chinook salmon in this region has been strongly affected by losses and alterations of freshwater habitat. Timber harvesting and associated road building have occurred throughout this region. Agriculture is also widespread in the lower portions of river basins and has resulted in widespread removal of riparian vegetation, rerouting of streams, degradation of streambanks, and summer water withdrawals. Urban development has substantially altered watershed hydrodynamics and affected stream channel structure in many parts of Puget Sound.

The peak recorded harvest in Puget Sound occurred in 1908, when 95,210 cases of canned Chinook salmon were packed. This corresponds to a run-size of approximately 690,000 Chinook salmon at a time when both ocean harvest and hatchery production were negligible. This estimate, as with other historical estimates, needs to be viewed cautiously; Puget Sound cannery pack probably included a portion of fish landed at Puget Sound ports but originating in adjacent areas, and the estimates of exploitation rates used in run-size expansions are not based on precise data. Recent mean spawning escapements totaling 71,000 correspond to a run entering Puget Sound of approximately 160,000 fish. Based on an exploitation rate of one-third in intercepting ocean fisheries, the recent average potential run-size would be 240,000 Chinook salmon (ACOE 2000a).

Life History

Chinook salmon prefer to spawn and rear in the mainstem of rivers and larger streams (Williams et al. 1975, Healey 1991). Although the incubation period is determined by water temperatures, fry typically hatch in about eight weeks (Wydoski and Whitney

1979, Healey 1991). After emergence, Puget Sound juvenile Chinook salmon migrate to the marine environment during their first year.

Rearing and development to adulthood occurs primarily in estuarine and coastal waters (NMFS 1998). The amount of time juvenile Chinook spend in estuarine areas depends upon their size at downstream migration and rate of growth. While residing in upper estuaries, juvenile prey mainly on benthic and epibenthic organisms such as amphipods, mysids, and cumaceans. Juveniles typically move into deeper waters when they reach approximately 65-75 mm in fork length. As the juveniles grow and move to deeper waters with higher salinities, their main prey changes to pelagic organisms such as decapod larvae, larval and juvenile fish, drift insects, and euphausids (Simenstad et al. 1977).

Hatchery Influence
By 1908 there were state-run and federally-run Chinook hatcheries operating in this ESU. Transfers of Chinook salmon eggs to Puget Sound from other regions especially the Lower Columbia River were common practices of early hatcheries (Meyers et al., 1998). By the 1920's several million Chinook salmon had been released into Puget Sound tributaries (Cobb, 1930). Recently, stock integrity and genetic diversity have become important objectives. New policies have been initiated to reduce the impact of hatchery fish on natural populations (WDF 1991, WDF et al.1993). The abundance of Chinook salmon in watersheds throughout this ESU has been closely related to hatchery efforts (Meyers et al. 1998).

WDFW classified 11 out of 29 stocks in this ESU as being sustained, in part, through artificial propagation. Nearly 2 billion fish have been released into Puget Sound tributaries since the 1950s. The vast majority of these have been derived from local returning fall-run adults. Returns to hatcheries have accounted for 57 percent of the total spawning escapement, although the hatchery contribution to spawner escapement is probably much higher than that, due to hatchery-derived strays on the spawning grounds (ACOE 2000a).

Population Trends and Risks
The abundance of Chinook salmon in this ESU has declined since historic levels. Widespread stream blockages have reduced available spawning habitat. Widespread release of hatchery fish from limited stocks, has increased the risks of loss of genetic diversity and fitness to natural populations. In addition the large numbers of hatchery releases masks natural population trends and making it difficult to determine their sustainability. Forestry practices, farming and urbanization have blocked or degraded fresh water habitat (Meyers et al., 1998).

4.B.2. Chum salmon

Chum salmon have the widest natural geographic distribution of all Pacific salmon species, ranging in Asia from Korea to the Russian Arctic coast and west to the Lena River, and in North America from Monterey, California, to the Arctic coast and east to the Mackenzie River (Beaufort Sea). Historically, they may have constituted up to 50 percent of the annual biomass of the seven species of Pacific salmon in the North Pacific Ocean (Salo 2003).

Chum salmon spawn successfully in streams of various sizes, and the fry migrate directly to the sea soon after emergence. The immature chum distribute themselves widely over the North Pacific Ocean, and maturing adults return to the home streams at various ages, usually at two through five years, and in some cases up to seven years (Salo 2003). Common to virtually every region of the chum salmon's area of distribution is the occurrence of early and late returning stocks to the natal stream. In North America the only true summer chum salmon may be in the Yukon River, where summer chum have the distinguishing characteristics of the Asian summer chum. From western Alaska south to British Columbia and Washington, there are runs referred to as "summer" chum, which spawn from June to early September; these chum are characterized by large body size, older age composition, and high fecundity, and are probably early autumn chum (Salo 2003).

In general, early-run chum spawn in mainstems of streams, while late spawners seek out spring water that has more favorable temperatures through the winter. The timing of the runs varies from north to south, as does age at maturity and absolute (and, probably, relative) fecundity (Salo 2003).

Hood Canal Summer Run Chum Salmon

The Hood Canal (HC) summer run chum salmon ESU was listed as threatened on August 2, 1999.

Geographic Boundaries and Spatial Distribution
This ESU includes summer-run chum salmon populations in Hood Canal in Puget Sound and in Discovery and Sequim Bays on the Strait of Juan de Fuca. It may also include summer-run fish in the Dungeness River, but the existence of that run is uncertain. Distinctive life-history and genetic traits were the most important factors in identifying this ESU. Hood Canal summer-run chum salmon are defined as fish that spawn from mid-September to mid-October in the mainstems of rivers (Johnson et al.1997).

Critical Habitat
Critical habitat for the Hood Canal chum salmon was first designated February 16, 2000. On April 30, 2002, the US District Court for the District of Columbia approved a NMFS consent decree withdrawing a February 2000 critical-habitat designation for this and 18 other evolutionary significant units (ESUs) (NMFS 2002). The final critical habitat was designated 09/02/05 (70 FR 52630). Current netpen locations do not overlap with the designated critical habitat of the Hood Canal chum salmon.

Historical Information
Hood Canal summer-run chum salmon are defined in SASSI (WDF et al. 1993) as fish that spawn from mid-September to mid-October. 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).

Life History
Chum salmon in Hood Canal have been classified as summer- and fall- returning stocks. Most Hood Canal summer-run chum spawn in early September to mid-October. The Union River summer chum run is an exception as they have an earlier spawning timing (September – early October). Fry emerge from February to June. In Washington, chum may reside in freshwater for as long as a month before migration to estuarine habitats where they remain for about a month before migrating to deeper water (Johnson et al.1997).

Hatchery Influence
Very few summer-run chum salmon have been artificially propagated in Hood Canal, and the only releases in recent years have been from newly established restoration programs. These recent releases totaled about 241,000 chum salmon fry into Hood Canal in 1993 and 1994 and about 85,000 fry into Discovery Bay on the Strait of Juan de Fuca in 1992. There has been little artificial propagation of summer chum salmon from the Strait of Juan de Fuca east of the Elwha River. Since 1992 a restoration egg box program has produced about 85,000 fry annually in Salmon Creek, a tributary to Discovery Bay. There are no records of summer-run chum salmon fry plants into other streams that enter the Strait of Juan de Fuca, including Jimmycomelately and Snow Creeks, or the Dungeness River (Johnson et al.1997).

Population Trends and Risks
This ESU is in danger of extinction. Of 12 streams in Hood Canal identified as recently supporting spawning populations of summer chum salmon, five may already have become extinct, six of the remaining seven showed strong downward trends in abundance, and all were at low levels of abundance. The populations in Discovery Bay and Sequim Bay were also at low levels of abundance with declining trends. Threats to the continued existence of these populations include degradation of spawning habitat, low water flows, and incidental harvest in salmon fisheries in the Strait of Juan de Fuca and Coho salmon fisheries in Hood Canal (Johnson et al. 1997).

4.B.3. Steelhead

The steelhead is the anadromous form of the rainbow trout (*O. mykiss*), which occurs in two subspecies, *O. mykiss irideus* and *O. mykiss gaidneri*. Whereas stream-resident rainbow trout may complete their life cycle in a limited area of a small stream and attain a length of only 8 inches or so, steelhead may spend half their lives at sea, roaming for thousands of miles in the North Pacific Ocean. Steelhead return to spawn at sizes ranging from about 24 inches and 5 pounds to about 36 to 40 inches or more and 20 pounds or more (Behnke 2002).

Biologically, steelhead can be divided into two reproductive ecotypes, based on their state of sexual maturity at the time of river entry. These two ecotypes are termed “stream-maturing” and “ocean-maturing”. Stream-maturing steelhead enter fresh water in a sexually immature condition and require from several months to a year to mature and spawn. These fish are often referred to as “summer run” steelhead. Ocean-maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. These fish are commonly referred to as “winter-run” steelhead. In the Columbia River basin, essentially all steelhead that return to streams east of the Cascade Mountains are stream maturing. Ocean-maturing fish are the predominate ecotype in coastal streams and lower Columbia River tributaries (ACOE 2000b).

All but one of the *O. m. gairdneri* steelhead populations migrating east of the Cascade Range are characterized as summer-run steelhead (entering the Columbia River from May into the early fall in October); the one exception is a winter-run steelhead spawning in Fifteenmile Creek, which drains the eastern side of the Cascades in Oregon. The genetic traits of Fifteenmile Creel steelhead make it intermediate between the subspecies *irideus* and *gairdneri*. Steelhead of the subspecies *irideus* are mainly winter-run fish, but *irideus* also has summer runs. Considering the entire range of *irideus* from California to Alaska, steelhead can be found entering one river or another in every month of the year (Behnke 2002).

Native steelhead in California generally spawn earlier than those to the north with spawning beginning in December. Washington populations begin spawning in February or March. Native steelhead spawning in Oregon and Idaho is not well documented. In the Clackamas River in Oregon, winter-run steelhead spawning begins in April and continues into June. In the Washougal River, Washington, summer-run steelhead spawn from March into June whereas summer run fish in the Kalama River, Washington spawn from January through April. Among inland steelhead, Columbia River populations from tributaries upstream of the Yakima River spawn later than most downstream populations.

Depending on water temperature, fertilized steelhead eggs may incubate in redds for 1.5 to 4 months before hatching as “alevins”. Following yolk sac absorption, young juveniles or “fry” emerge from the gravel and begin active feeding. Juveniles rear in fresh water for 1 to 4 years, then migrate to the ocean as smolts. Downstream migration of wild steelhead smolts in the lower Columbia River begins in April, peaks in mid-May and is essentially complete by the end of June (ACOE 2000b). Previous studies of the timing and duration of steelhead downstream migration indicate that they typically move quickly through the lower Columbia River estuary with an average daily movement of about 21 kilometers (ACOE 2000b).

Juvenile steelhead generally spend two years in freshwater before smolting and migrating to the ocean at lengths of about 6 to 8 inches. Most steelhead return to their natal rivers to spawn after spending 15 to 30 months in the ocean. Unlike Pacific salmon, steelhead do not all die soon after spawning, but the rate of survival to repeat spawning is generally low - about 10 percent (Behnke 2002).

Puget Sound Steelhead ESU

The Puget Sound steelhead ESU was found to not warrant listing on August 9, 1996. On March 29, 2006 in response to a petition, NOAA Fisheries Service announced that it was proposing to list this Distinct Population Segment (DPS) as "threatened". The Puget Sound steelhead ESU was officially listed as "threatened" on March 11, 2007. The following summary is taken from NMFS (2005).

Geographic Boundaries and Spatial Distribution
The Puget Sound steelhead DPS includes all naturally spawned anadromous winter-run and summerrun *O. mykiss* (steelhead) populations in streams of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, basins. This area is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks.

Critical Habitat
The Puget Sound steelhead DPS critical habitat is currently under development due to its recent status as "threatened".

Historical Information
The analysis of catch records from 1889 indicate a catch peak of 163,796 steelhead in 1895. Using estimates of harvest rate of 30-50%, the estimated peak run size ranged from 327,592-545,987 steelhead for the Puget Sound at that time. A survey of the Puget Sound in 1929 and 1930 identified steelhead in every major basin except the Deschutes River. By the late 1920s, steelhead abundance had already undergone significant declines and many marginal or ephemeral populations may have already disappeared. Steelhead were a target species for harvest as the winter run occurred during the months of the year when salmon fisheries were at seasonal lows. By 1898, the Washington State Fish Commissioner considered Puget Sound Steelhead to be "greatly depreciated" and catches continued to decline from 1900 through the 1920s. In 1925, steelhead were classified by Washington State as a sportfish and in 1932 the State prohibited the commercial catch of steelhead. All further run-size estimates were based on sportfish catch records and spawning surveys.

In the 1980s, the Puget Sound steelhead run size was estimated as 100,000 winter-run and 20,000 summer-run. In the 1990s, the total run size for major stocks in this ESU was greater than 45,000 with natural escapement estimates of 22,000 steelhead.

Habitat and Hydrology
Habitat utilization by steelhead has been most dramatically affected by a number of large dams in Puget Sound basins. Besides eliminating access to habitat, dams affect habitat quality by changing river hydrology, temperature profiles, gravel recruitment, and large woody debris movement and stability. Urban development and suburbanization have resulted in the loss of historical land cover, often replacing it with imperious surface. Combined with loss of wetland/riparian habitat, hydrology of many urban streams has changed dramatically. Flood frequency and peak flow during storm events has increased and groundwater derived summer flows have decreased. Land development for agriculture has also altered historical land cover. Because much of this type of development took place in river floodplains, direct impacts to river morphology have resulted. Diking, riprapping of banks, and channelization have resulted in river

constriction which increases gravel scour, decreases habitat complexity, and alters amplitude of high flow events.

Hatchery Influence
Releases of hatchery propagated steelhead into Puget Sound waters began in the 1900s and by the 1940s, extensive hatchery rearing programs were developed. Hatchery fish were widespread, spawning naturally throughout the region, and were largely derived from a single stock (Chambers Creek). In the 1980s, the hatchery portion of the population based on ocean catches was 70%. Over the last two decades, release levels of hatchery steelhead have remained relatively constant. Hatchery–produced winter steelhead have been released in nearly every basin in the ESU, except for the Cedar River and some smaller tributaries.

The risk posed by artificial production programs to natural production in the Puget Sound steelhead ESU is not clear as definitive information is not available. However, the genetic and life-history relationships between the Chambers Creek Hatchery and Skamania Hatchery and the naturally-spawning populations indicate that these hatchery effects could be substantially detrimental.

Population Trends and Risks
NMFS concluded that the Puget Sound steelhead DPS is not presently in danger of extinction, nor is it likely to become endangered in the foreseeable future. Despite this conclusion, NMFS has several concerns about the overall health of this DPS and about the status of certain stocks within the DPS. Recent trends in stock abundance are predominantly downward, although this may be largely due to recent climate conditions. Trends in the two largest stocks (Skagit and Snohomish rivers) have been upward. The status of certain stocks within the DPS is also of concern, especially the depressed status of most stocks in the Hood Canal area and the steep declines of Lake Washington winter steelhead and Deer Creek summer steelhead. Habitat loss, hatchery steelhead introgression, and harvest are the major contributors to the decline of steelhead in this ESU.

4.B.4. Bocaccio[11]

Species Description
Bocaccio are large Pacific coast rockfish that reach up to 3 feet (1 m) in length. They have a distinctively long jaw extending to at least the eye socket. Their body ranges in color from olive to burnt orange or brown as adults. Young bocaccio are light bronze in color and have small brown spots on their sides.

Rockfishes are unusual among the bony fishes in that fertilization and embryo development is internal, and female rockfish give birth to live larval young. Larvae are found in surface waters, and may be distributed over a wide area extending several hundred miles offshore. Fecundity in female bocaccio ranges from 20,000 to over two

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[11] NOAA Fisheries. Office of Protected Resources. Bocaccio *(Sebastes paucispinis).* http://www.nmfs.noaa.gov/pr/species/fish/bocaccio.htm

million eggs, considerably more than many other rockfish species. Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents.

Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of rockfish, associated with kelp beds, rocky reefs, pinnacles, and sharp dropoffs. Approximately 50 percent of adult bocaccio mature in 4 to 6 years. Bocaccio are difficult to age but are suspected to live as long as 50 years.

Habitat
Bocaccio are most common between 160 and 820 feet (50-250 m) depth, but may be found as deep as 1,560 feet (475m). Adults generally move into deeper water as they increase in size and age but usually exhibit strong site fidelity to rocky bottoms and outcrops. Juveniles and subadults may be more common than adults in shallower water, and are associated with rocky reefs, kelp canopies, and artificial structures, such as piers and oil platforms.

Distribution
Bocaccio range from Punta Blanca, Baja California, to the Gulf of Alaska off Krozoff and Kodiak Islands. They are most common between Oregon and northern Baja California. In Puget Sound, most bocaccio are found south of Tacoma Narrows.

Population Trends
Recreational catch and effort data spanning 12 years from the mid-1970s to mid-1990s suggests possible declines in abundance in Washington. Additional data over this period show the number of angler trips increased substantially and the average number of rockfish caught per trip declined. Taken together, these data suggest declines in the population over time. Currently there are no survey data being taken for this species, but few of these fish are caught by fishermen and none have been caught by Washington state biological surveys in 20 years, suggesting a very low population abundance. They are thought to be at an abundance that is less than 10% of their unfished abundance.

A 2005 stock assessment by NOAA Fisheries suggests bocaccio there have higher populations than was thought to be the case.

Threats
Bocaccio are fished directly and are often caught as bycatch in other fisheries, including those for salmon. Adverse environmental factors led to recruitment failures in the early- to mid-1990s.

Conservation Efforts
Various state restrictions on fishing have been put in place over the years. Current regulations in the state of Washington, where the species is most at risk, limit the daily rockfish catch to three rockfish total (of any species). Because this species is so slow-

growing, late to mature, and long-lived, recovery from the above threats will take many years, even if the threats are no longer affecting the species.

4.B.5. Canary Rockfish[12]

Species Description

Canary rockfish are large rockfish that reach up to 2.5 feet (77 cm) in length and 10 pounds (4 kg) in weight. Adults have bright yellow to orange mottling over gray, 3 orange stripes across the head, and orange fins. Animals less than 14 inches long have dark markings on the posterior part of the spiny dorsal fin and gray along the lateral line. Rockfishes are unusual among the bony fishes in that fertilization and embryo development is internal and female rockfish give birth to live larval young. Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. Fecundity in female canary rockfish ranges from 260,000 to 1.9 million eggs, considerably more than many other rockfish species. Larvae and small juvenile rockfish may remain in open waters for several months, being passively dispersed by ocean currents.

Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of rockfish, associated with kelp beds, rocky reefs, pinnacles, and sharp dropoffs. Approximately 50 percent of adult canary rockfish are mature at 14 inches (36 cm) total length (about 5 to 6 years of age). Canary rockfish can live to be 75 years old.

Habitat

Canary rockfish primarily inhabit waters 160 to 820 feet (50 to 250 m) deep but may be found to 1400 feet (425 m). Juveniles and subadults tend to be more common than adults in shallow water and are associated with rocky reefs, kelp canopies, and artificial structures, such as piers and oil platforms. Adults generally move into deeper water as they increase in size and age but usually exhibit strong site fidelity to rocky bottoms and outcrops where they hover in loose groups just above the bottom.

Distribution

Canary rockfish range between Punta Colnett, Baja California, and the Western Gulf of Alaska. Within this range, canary rockfish are most common off the coast of central Oregon.

Population Trends

Recreational catch and effort data spanning 12 years from the mid-1970s to mid-1990s suggests possible declines in abundance. While catch data are generally constant over this time period, the number of angler trips increased substantially, and the average number of canary rockfish caught per trip declined. Taken together, these data suggest declines in the population over time. Currently there are no survey data being taken for

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[12] NOAA Fisheries. Office of Protected Resources. Canary Rockfish *(Sebastes pinniger).* http://www.nmfs.noaa.gov/pr/species/fish/canaryrockfish.htm

this species, but few of these fish are currently caught by fishermen, suggesting a low population abundance. Canary rockfish used to be one of the three principal species caught in Puget Sound in the 1960s.

Threats
Canary rockfish are fished directly and are often caught as bycatch in other fisheries, including those for salmon. Adverse environmental factors led to recruitment failures in the early- to mid-1990s.

Conservation Efforts
Various state restrictions on fishing have been put in place over the years, including banning retention of canary rockfish in Washington in 2003. Because this species is slow growing, late to mature, and long-lived, recovery from these threats will take many years, even if the threats are no longer affecting the species.

4.B.6. Yelloweye Rockfish[13]

Species Description
Yelloweye rockfish are very large rockfish that reach up to 3.5 feet (~1 m) in length and 39 pounds (18 kg) in weight. They are orange-red to orange-yellow in color and may have black on their fin tips. Their eyes are bright yellow. Adults usually have a light to white stripe on the lateral line; juveniles have 2 light stripes, one on the lateral line and a shorter one below the lateral line.

Rockfishes are unusual among the bony fishes in that fertilization and embryo development is internal and female rockfish give birth to live larval young. Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. Fecundity in female yelloweye rockfish ranges from 1.2 to 2.7 million eggs, considerably more than many other rockfish species. Larvae and small juvenile rockfish may remain in open waters for several months being passively dispersed by ocean currents.

Larval rockfish feed on diatoms, dinoflagellates, tintinnids, and cladocerans, and juveniles consume copepods and euphausiids of all life stages. Adults eat demersal invertebrates and small fishes, including other species of rockfish, associated with kelp beds, rocky reefs, pinnacles, and sharp dropoffs. Approximately 50 percent of adult yelloweye rockfish are mature by 16 inches (41 cm) total length (about 6 years of age). Yelloweye rockfish are among the longest lived of rockfishes, living up to 118 years old.

Habitat
Juveniles and subadults tend to be more common than adults in shallower water, and are associated with rocky reefs, kelp canopies, and artificial structures such as piers and oil platforms. Adults generally move into deeper water as they increase in size and age, but usually exhibit strong site fidelity to rocky bottoms and outcrops. Yelloweye rockfish

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[13] NOAA Fisheries. Office of Protected Resources. Yelloweye Rockfish *(Sebastes ruberrimus).* http://www.nmfs.noaa.gov/pr/species/fish/yelloweyerockfish.htm

occur in waters 80 to 1560 feet (25 to 475 m) deep, but are most commonly found between 300 to 590 feet (91 to 180 m).

Distribution
Yelloweye rockfish range from northern Baja California to the Aleutian Islands, Alaska, but are most common from central California northward to the Gulf of Alaska.

Population Trends
Recreational catch and effort data spanning 12 years from the mid-1970s to mid-1990s suggests possible declines in abundance. While catch data are generally constant over time, the number of angler trips increased substantially, and there was a decline in the average number of rockfish caught per trip. Taken together, these data suggest declines in the population over time. Currently there are no survey data being taken for this species, but few of these fish are caught by fishermen, suggesting a low population abundance.

Threats
Yelloweye rockfish are fished directly and are often caught as bycatch in other fisheries, including those for salmon. Adverse environmental factors led to recruitment failures in the early- to mid-1990s.

Conservation Efforts
Various state restrictions on fishing have been put in place over the years leading to the current ban on retention of yelloweye rockfish in Washington in 2003. Because this species is slow growing, late to mature, and long-lived, recovery from these threats will take many years, even if the threats are no longer affecting the species.

4.C. LIFE HISTORY OF MARINE MAMMAL ASSESSED[14]
Life history, status, and other pertinent information for the three marine mammals assessed in this BE are presented in this section.

4.C.1. Steller sea lion (eastern population)

Status
The Steller sea lion was listed as a threatened species under emergency rule by NMFS in April 1990; final listing for the species became effective in December 1990.

Geographic Range and Spatial Distribution
Steller sea lions are polygamous and use traditional territorial sites for breeding and resting. Breeding sites, also known as rookeries, occur on both sides of the north Pacific, but the Gulf of Alaska and Aleutian Islands contain most of the large rookeries. Adults congregate for purposes other than breeding in areas known as haulouts (USEPA 2002b). The following are steller sea lion haulout sites in Puget Sound: Bangor Naval Base; east

[14] Life History information in this section is from the Washington BE for the 2003/2006 WQS Revisions, April 10, 2007. Please see that document for more information on the references cited within this section. The sources cited in this section are not included in the Reference section of this BE.

of Marrowstone Island; Toliva Shoals Buoy; Docks on Saltair Marina; Navigation Buoys and Netpen Floats near Orchard Rocks/NMFS Manchester; Old Shipwreck on North Side of Nisqually River Delta; and Navigation Buoys between Point Wilson and Point No Point.[15] In addition, as many as 20 Steller sea lions have been observed hauled out on American Gold Seafoods equipment storage barges near the existing netpen facilities in Rich Passage.[16]

In 1997, NMFS classified Steller sea lions into two distinct population segments divided by the 144°W latitude. The eastern population segment occupies habitat including southeastern Alaska and Admiralty Island. Currently, NMFS has classified the western population segment as endangered, while classifying the eastern population segment as threatened (62FR24345). Although the Steller sea lion population has declined steadily for the last 30 years, scientists have yet to identify the cause of the decline (USEPA 2002b).

Steller sea lions may be observed in Puget Sound year-round, but they are most abundant during the fall and winter months. Three major haulout areas exist on the Washington outer coast and one major haulout area is located at the Columbia River south jetty.

No breeding rookeries have been identified in Washington waters (NMFS 1992).

Critical Habitat

Steller sea lion critical habitat has been designated in Alaska, California, and Oregon and includes a 20-nautical-mile buffer around all major haulouts and rookeries, as well as associated terrestrial, air, and aquatic zones, and three large offshore foraging areas. No critical habitat has been designated in Washington.

Life History

Steller sea lion habitat includes both marine and terrestrial areas that are used for a variety of purposes. Terrestrial areas (e.g., beaches) are used as rookeries for pupping and breeding. Rookeries usually occur on beaches with substrates that include sand, gravel, cobble, boulder, and bedrock (NMFS 1992). Haul-out areas are used other than during the breeding and pupping season. Sites used as rookeries may be used as haul-out areas during other times of the year. When Steller sea lions are not using rookery or haul-out areas, they occur in nearshore waters and out over the continental shelf. Some individuals may enter rivers in pursuit of prey (Jameson and Kenyon 1977).

Steller sea lions are opportunistic feeders and consume a variety of fishes such as flatfish cod, and rockfish; and invertebrates such as squid and octopus. Demersal and off-bottom schooling fishes predominate (Jones 1981). Steller sea lions along the coasts of Oregon and California have eaten rockfish, bake, flatfish, cusk-eel, squid, and octopus (Fiscus and Baines 1966, Jones 1981, Treacy 1985); rockfish and hake are considered to be

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[15] Personal communication between Matthew Szelag, EPA and Teresa Mongillo, NOAA. September 22, 2010. Provided information from Jeffries et al. 2000: Navy; WDFW; NMML.

[16] March 16, 2010. Letter from Barry A. Thom, Acting Regional Administrator, Northwest Region, NMFS to Michelle Walker, Chief, Seattle Regulatory Branch, U.S. Army Corps of Engineers Re: ESA and EFH Consultation for American Gold Seafoods Net-Pen Array Relocation.

consistently important prey items (NMFS 1992). Feeding on lamprey in estuaries and river mouths has also been documented at sites in Oregon and California (Jones 1981, Treacy 1985). Spalding (1964) and Otesiku et al. (1990) have documented Steller sea lions feeding on salmon, but they are not considered to be a major prey item (Osborne 1988).

The breeding range of Steller sea lions extends from southern California to the Bearing Sea (Osborne 1988). Breeding colonies consisting of small numbers of sea lions also exist on the outer coasts of Oregon and British Columbia. There are currently no breeding colonies in Washington State (NMFS 1992), although three major haul-out areas exist on the Washington outer coast and one major haul-out area is located at the Columbia River south jetty (NMFS 1992). None of these haul-out areas are located within the action area of Puget Sound for this action. Jagged Island and Spit Rock are used as summer haul-outs, and Umatilla Reef is used during the winter (National Marine Mammal Laboratory, unpublished data). Other rocks, reefs, and beaches as well as floating docks, navigational aids, jetties, and breakwaters are also used as haul-out areas (NMFS 1992).

Population Trends and Risks
The worldwide Steller sea lion population is estimated at just under 200,000, with the majority occurring in Alaska. The range of the Steller sea lion extends around the North Pacific Ocean rim from northern Japan, the Kuril Islands and Okhotsk Sea, through the Aleutian Islands and Bering Sea, along Alaska's southern coast, and south to California (Kenyon and Rice 1961, Loughlin et al. 1984).

Responses to various types of human-induced disturbances have not been specifically studied. Close approach by humans, boats, or aircraft will cause hauled-out sea lions to go into the water. Disturbances that cause stampeeds on rookeries may cause trampling and abandonment of pups (Lewis 1987). Areas subjected to repeated disturbance may be permanently abandoned (Kenyon 1962), and/or the repeated disturbance may negatively affect the condition or survival of pups through interruption of normal nursing cycles. Low levels of occasional disturbance may have little long-term effect (NMFS 1992).

4.C.2. Humpback whale

Status
Humpback whales are listed as endangered throughout their entire range under the Endangered Species act on June 2, 1970 (35 FR 8491).

Geographic Boundaries and Spatial Distribution
Surveys indicate that humpbacks occupy habitats around the world, with three major distinct populations: the north Atlantic, the north Pacific, and the southern oceans. These three populations do not interbreed. Humpbacks generally feed for 6-9 months of the year on their feeding grounds in Arctic and Antarctic waters. The animals then fast and live off their fat layer for the winter period while on the tropical breeding grounds (USEPA 2002b). The north Pacific herd of humpback whales that typically occupies southeastern Alaska waters also migrates to Hawaii and Mexico in the winter months for breeding. Humpback whales in the North Pacific are seasonal migrants feeding on

zooplankton, and small schooling fish in coastal waters off the coastal waters of the western United States, Canada (NMFS 2002).

Humpback whales are not expected to be routinely present in Washington waters or the waters potentially affected by this action.

Critical Habitat
There is no designated critical habitat for the humpback whale.

Historical Information
Whaling took large numbers of humpbacks from the late 1800s through the early 20th century. Even though the International Whaling Commission provided protection to the species in the early 1960s, the Soviet Union has recently revealed massive illegal and unreported kills that occurred up until 1970 in the southern oceans.

Population Trends and Risks
The humpback whale population is listed as "depleted" under the Marine Mammal Protection Act. As a result, the Central North Pacific population of humpback whale is classified as a strategic stock. The Central North Pacific population has increased in abundance between the early 1980s and early 1990s; but the status of this population relative to its optimum sustainable population size is unknown (NMFS 2002).

The largest threats to their survival include entanglements in fishing gear, collisions with ship traffic, and pollution of their coastal habitat from human settlements (USEPA 2002b).

4.C.3. Killer whale

Status
NOAA Fisheries Service received a petition in 2001 to list Killer Whales under the Endangered Species Act. In May 2003 the species was determined to be depleted under the Marine Mammal Protection Act which began the process to identify site specific measures to address the potential factors for decline. The proposal to list the Southern Resident killer whale distinct population segment (DPS) as threatened under the ESA was announced December 16, 2004. The final listing of this DPS as endangered was November 18, 2005 (70 FR 69903).

Life History
Killer whales grow to considerable size. The males can reach lengths of 25 feet or more and weigh five tons, females are typically a little smaller. This species ranges world wide including the Atlantic Ocean as far north as Iceland south to Antarctica. Killer whales are primarily piscivores. Based on a study that included both Northern and Southern DPS whales, salmon were found to represent over 96% of the prey during summer and fall. Chinook salmon were the preferred prey species comprising 70% of the species taken despite the relatively low abundance of Chinook in these areas compared to other species. Chum salmon were consumed extensively in the fall. Other prey species of Southern Resident killer whales include flatfish, lingcod, greenling, and squid.

Geographic Boundaries and Spatial Distribution
Resident killer whales in U.S. waters are distributed from Alaska to California, with four distinct communities recognized: Southern, Northern, Southern Alaska, and Western Alaska. The Southern Resident DPS consists of three pods named J, K, and L. These pods reside for part of the year in the inland waterways of Washington State and British Columbia (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound), principally during late spring, summer, and fall. Pods visit coastal sites off Washington and Vancouver Island. Offshore movements and distribution are largely unknown for this DPS.

Critical Habitat
Critical habitat was proposed for the Southern Resident DPS of killer whales on 06/15/06 (50 FR 34571) and the final Critical habitat Rule was issued 11/29/06 (50 CFR Part 226). Killer whale habitat is not believed to be constrained by water depth, temperature or salinity. Three specific areas are designation: the summer core area in Haro Strait and waters around the San Juan Islands; Puget Sound; and the Strait of Juan de Fuca, spanning a total of 2560 square miles. Excluded are 18 military sites for national security purposes, comprising approximately 112 square miles.

Population Trends and Risks
Based on information collected mainly in summer seasons, the number of Southern Resident killer whales has never been large, numbering between 100 and 200 prior to 1960. Annual censuses of this DPS began in 1973. At that time live captures of these whales for the marine parks, reduced their numbers to fewer than 70 animals. All three of the pods were affected by this activity.

There are large differences in the survival rates of Southern Residents among different age and sex categories. Reproductive age females had the highest survival rate, followed by juveniles, post-reproductive age females, and young males. Calves and old males had the lowest survival rates.

The Southern Resident population has fluctuated considerably over the 30 years that it has been studied. In 1974 it comprised 71 whales, peaked at 97 animals in 1996, and then declined to 79 in 2001. The population now numbers in the high 80s.

The Southern Resident population is at risk for both incremental small-scale impacts over time (e.g. reduced fecundity or subadult survivorship) or to major catastrophe (e.g. oil spill or disease outbreak). The small size of this DPS makes it potentially vulnerable to allele effects (e.g. inbreeding depression) that could cause decline.

There are limited numbers of reproductive-age Southern Resident males and several females of reproductive age are not having calves. The factors causing the decline of Southern Residents are not well known. Some of the possible causes of decline are: reduced quantity and quality of prey; persistent pollutants that could cause immune or reproductive system dysfunction; oil spills; and noise and disturbance from vessels.

4.D. BIOLOGICAL REQUIREMENTS IN THE ACTION AREA[17]

The biological requirements of the Action Area related to listed species are those physical or biological features that are essential to conservation of the species. An accurate description of these features is best derived from the NMFS-FWS regulations for listed species and designated critical habitat which states that the agencies must consider those physical and biological features that are essential to the conservation of a given species (FR vol.71, no.229, 69060). These features are called Primary Constituent Elements (PCE) are described by NMFS-FWS for each listed fish species. The requirements related to PCEs include: 1) space for growth and normal behavior; 2) food, water, air, light necessary for physiological requirements; 3) cover/shelter; 4) sites for breeding, reproduction, and rearing; 5) habitats that are protected from disturbance or represent ecological distribution of species.

The PCEs for listed salmon species are similar among species and NMFS lists the same ones for the 12 ESU of west coast salmon and steelhead in Washington, Idaho, and Oregon (70 FR 52630 vol. 70 No. 170). The six PCEs for salmon are: 1) freshwater spawning sites with water quantity and quality conditions and substrate to support spawning, incubation, and larval development, 2) Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions; water quality and forage, and natural cover such as shade, large wood, side channels all necessary for juveniles to forage, grow and develop behaviors for survival; 3) freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover to support juvenile and adult mobility and survival; 4) estuarine areas free of obstructions with water quantity and quality and salinity to support both adult and juvenile physiological transition between fresh and salt water environments, cover, and forage; 5) nearshore marine areas free of obstruction with water quality and quantity conditions, forage, and cover; 6) Off shore marine areas with water quality conditions and forage.

There are no PCEs for the three rockfish species.

For Steller sea lion the habitat requirements are breeding rookeries, haulout sites, feeding areas, and nutritional requirements. Also terrestrial habitats adjacent to rookeries are important. FR (55 FR 49204).

There are no PCEs for the humpback whale.

For the killer whale, the PCEs are: 1) water quality to support growth and development, 2) sufficient quality and quantity of prey species, 3) sound levels that do not exceed thresholds that inhibit communication, 4) passage conditions to support migration and foraging (FR vol.71, No. 115 pg 34573).

[17] Life History information in this section is from the Washington BE for the 2003/2006 WQS Revisions, April 10, 2007. Please see that document for more information on the references cited within this section. The sources cited in this section are not included in the Reference section of this BE.

5. ENVIRONMENTAL BASELINE

Puget Sound is the action area for EPA's approval discussed in this Biological Evaluation. In 2000, approximately four million people lived in the Puget Sound region and this number is expected to grow to five million by 2020. Rapid urbanization has increased the human impact on Puget Sound, contributing to water pollution, sediments with toxic pollutants, declines in native species populations and their habitats, and closure of shellfish beds.[18] The environmental impacts of contamination from point sources (such as wastewater treatment facility discharges), and, increasingly, nonpoint sources (such as stormwater runoff) has adversely affected the water quality of Puget Sound.

Atlantic salmon rearing began in the 1970s; however, commercial facilities became prevalent between the mid 1980s to the mid 1990s in Puget Sound.[19] Ten commercial facilities were present in 2002 and eight currently exist. Puget Sound facilities appear to be in decline. Consolidation to a few large companies has been a characteristic of the finfish rearing industry which has been evidenced by all eight netpen facilities now owned by Icicle Acquisition Subsidiary, LLC. Similar consolidation has been occurring worldwide. Since the marine finfish rearing facility provision has been in Washington's SMS since 1996, and was in effect for CWA purposes after the Alaska Rule in 2000, EPA's approval is not likely to create a significant increase in facilities. In 2001, approximately 10 million pounds of Atlantic salmon were produced in Washington, in ten netpens. In British Columbia, where fish farms are more prevalent, 100 million pounds were produced in about 85 netpens of which 80% were Atlantic salmon.[20]

The primary habitat feature that may be affected by the proposed action is impact to the benthic community in Puget Sound directly under licensed marine finfish rearing facility and their sediment impact zones, which typically extend 100 feet outward from the facilities in each direction in compliance with WAC 173-204-412. These facilities may have an environmental effect on the seafloor due to the accumulation of nutrient-rich solids (e.g., uneaten food and fish feces). While sediment impacts are expected in these areas, no exceedances of the Washington's water quality standards are allowed, and therefore, no water column affects are expected or allowed. Water and sediment quality standards are important mechanisms to control pollutants in the action area to protect species dependent upon the aquatic environment. In this case, sediment quality standards related to marine finfish rearing facilities are evaluated as a point source permitted under the National Pollutant Discharge Elimination System (NPDES) and licensed/sited under Washington Department of Natural Resources (WDNR) regulations. EPA is proposing to approve the sediment standards applicable to marine finfish rearing facilities.

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[18] Puget Sound Action Team. About Puget Sound. Accessed online March 7, 2008. <http://www.psat.wa.gov/About_Sound/AboutPS.htm>

[19] Washington Department of Natural Resources. "Potential Offshore Finfish Aquaculture in the State of Washington." Technical Report, Aquatic Resources Division. May 1999. <http://www.fao.org/fi/gisfish/cds_upload/1142847098523_Ladenburg___Sturges_1999_210.pdf>

[20] Washington State Department of Fish and Wildlife. "Atlantic Salmon in Washington State." Fact Sheet. August 2001. <http://wdfw.wa.gov/factshts/atlanticsalmon.htm>

Water quality standards enhance the effectiveness of many of the state, local, and federal water quality programs, including point source permit programs, nonpoint source control programs, development of total maximum daily load limitations (TMDLs), and ecological protection efforts. Data acquired during chemical, physical, and biological monitoring studies is utilized in evaluating the quality of the State's waters and designing appropriate water quality controls. Waters identified as "water quality limited" are included on the 303(d) list, submitted to EPA biennially. None of the areas under currently sited for netpens are listed as impaired waters on Ecology's most recent 303(d) list.

More information is available at:
http://www.ecy.wa.gov/programs/wq/303d/2002/2004_documents/contam_sed_listings-2004.pdf

The 2004 Water Quality Assessment Category 5 Sediment Listings can be found at:
http://www.ecy.wa.gov/programs/wq/303d/2002/2004_documents/sediment_pdfs1105/sediment-110205-cat5.pdf

There are many Puget Sound monitoring reports and assessments related to sediment quality. Examples include:

"Puget Sound Ambient Monitoring Program 1992: Marine Sediment Monitoring Task"
Washington State Department of Ecology
http://www.ecy.wa.gov/pubs/9387.pdf

"Recommended Protocols for Sampling and Analyzing Subtidal Benthic Macroinvertebrate Assemblages in Puget Sound"
1987, EPA Region 10 and Puget Sound Water Quality Authority
http://www.psat.wa.gov/Publications/protocols/protocol_pdfs/benthos.pdf

"Sediment Quality in Puget Sound"
2002, Washington State Department of Ecology and NOAA
http://www.ecy.wa.gov/pubs/0203033.pdf

6. ANALYSIS OF EFFECTS

Implementing regulations (50 CFR 402.02) for the ESA Section 7 define "effects of the action" as:

> The direct and indirect effects of an action on the species or critical habitat together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur (50 CFR 402.02).

EPA's approval of Washington's revised sediment management standards and in particular the marine finfish rearing facility provision WAC 173-204-412, will not change the environmental baseline or directly affect ESA listed or proposed species. However, there are potential indirect effects to ESA listed or proposed species through NPDES permitting that includes the revised SMS provisions. Therefore, the effects analysis below describes the potential indirect effects from EPA's approval action.

There are three possible determinations of effects under the ESA (USFWS and NMFS 1998). The determinations and their definitions are:

- **No Effect (NE) –** the appropriate conclusion when the action agency determines its proposed action will not affect listed species or critical habitat.

- **May affect, but is not likely to adversely affect (NLAA) –** the appropriate conclusion when effects on listed species are expected to be discountable, or insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

- **May affect, likely to adversely affect (LAA) –** the appropriate conclusion if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial. In the event the overall effect of the proposed action is beneficial to the listed species, but also is likely to cause any adverse effects, then the proposed action "is likely to adversely affect" the listed species. An “is likely to adversely affect” determination requires formal section 7 consultation.

6.A. ANALYSIS OF EFFECTS FINDINGS

This analysis assumes there will not be a large increase in the number of netpen facilities in Puget Sound, that Atlantic salmon is the fish species reared in those netpen facilities, and that the regulatory structure remains intact. EPA’s approval and ESA determinations are based on the following six key findings along with information contained within the recovery plans.

- The designated uses of Puget Sound are protected.
- Netpen facilities have an insignificant impact on aquatic life in Puget Sound.
- The existing regulatory framework for netpens provides protection to surrounding habitat and other species.
- The effects on the benthic community are accounted for and monitored.
- The closure procedures of netpen facilities ensure the aquatic environment is restored to baseline levels.
- The indirect effects of netpen facilities carry a low risk.

These six findings, described in further detail below, are supported by information contained in the following three documents:

1) “Beneficial Environmental Effects of Marine Finfish Mariculture” J.E. Rensel and J.R.M. Forster. July 2007.

This report discusses the findings of a NOAA survey that was conducted from 2004-2006 at a commercial netpen farm in northern Puget Sound. The study found that netpens in Puget Sound provide a beneficial effect since they provide enhanced habitat for diverse populations of invertebrates and seaweeds. Therefore, the biofouling associated with netpens can be considered “beneficial” to species diversity and richly-populated marine food webs. The study also found that vaccines are typically used in place of antibiotics, sea lice problems do not exist due to natural salinity levels and facility location accounts for depth and current conditions that distribute netpens wastes over large areas where it may be incorporated into the food web.

2) “Review of Potential Impacts of Atlantic Salmon Culture on Puget Sound Chinook Salmon and Hood Canal Summer-Run Chum Salmon Evolutionarily Significant Units” F. William Waknitz. June 2002.

This NOAA technical memorandum examines the impacts of Atlantic salmon netpens on threatened salmon species found in Puget Sound. The report finds that escaped Atlantic salmon present a low risk to infect wild salmon, a low risk to compete with wild salmon for food or habitat, and a low risk to adversely impact Essential Fish Habitat. The study also finds there to be little risk regarding: hybridization between Atlantic and Pacific salmon; colonization of wild salmon habitat; Atlantic salmon feeding on Pacific salmon;

pathogen transmission from Atlantic salmon to wild salmon; and, antibiotic-resistant bacteria development as a result of Atlantic salmon farming.

3) "The Net-pen Salmon Farming Industry in the Pacific Northwest" Colin Nash. September 2001.

This NOAA technical memorandum evaluates the risks associated with salmon netpen farming in the Pacific Northwest. This analysis finds the following issues carry the most risk: the impact of bio-deposits from farm operations on the environment beneath the netpens, the impact on benthic communities by the accumulation of heavy metals, and the impact on non-target organisms by the use of therapeutic compounds. Several of these issues have been addressed by Puget Sound facilities since this report was written in 2001. This memorandum finds several issues which carry a low risk: the physiological effect of low dissolved oxygen levels, the toxic effect of hydrogen sulfide and ammonia from netpen bio-deposits, the toxic effect of algal blooms, changes in the epifaunal community caused by the organic waste accumulation in sediments, the proliferation of human pathogens in the aquatic environment, the proliferation of fish and shellfish pathogens in the aquatic environment and the increased incidences of disease among wild fish. The technical memorandum also finds the escape of Atlantic salmon and the impact of antibiotic-resistant bacteria on native salmonids to carry very little or no risk.

6.A.1. The Designated Uses of Puget Sound are Protected

EPA's approval of the marine finfish rearing facility provision protects the designated uses of Puget Sound as a whole. Netpen facilities must meet Washington's water quality standards because no mixing area is permitted in the water column. These standards include Washington's narrative water quality criteria for toxic, radioactive, or other deleterious material concentrations that have the potential to adversely affect designated water uses, cause acute or chronic toxicity to biota, impair aesthetic values and adversely affect human health. (WAC 173-201A-260(2))

Refer to WAC 173-201A-210 for Marine water designated uses and criteria. (page 16)
Refer to WAC 173-201A-612 for Use designations for marine waters (pages 111-113)
http://www.ecy.wa.gov/pubs/0610091.pdf

In 1997, several environmental groups challenged Washington's Pollution Control Hearings Board (PCHB) issuance of marine finfish rearing facility NPDES permits for compliance with the CWA and the State Environmental Policy Act (SEPA). At the time, PCHB found that the

> Permittees' facilities do not create unresolved conflicts with alternative uses of Puget Sound resources as contemplated by RCW 43.32C.030(2)(e). The existence of commercial salmon farms as permitted uses does not preclude other beneficial uses in Puget Sound, such as shellfish harvesting, commercial or sport fishing, navigation or recreational boating. Likewise, the existence of the salmon farms does not operate to the exclusion of available resources, such as native salmon runs, sediment and water quality, or marine mammals. In short, salmon farming

> in Puget Sound does not present the citizens of the State of Washington with an 'either/or' choice with respect to other beneficial uses and important resources.[21]

This decision was upheld in a PCHB final ruling in November 1998.

In addition, EPA's approval of WAC 173-204-412(4)(b), allows Ecology to issue administrative orders and to issue permits that describe the establishment, maintenance and closure requirements of marine finfish rearing facilities. WAC 173-204-412 authorizes Ecology to increase the stringency of netpen requirements if the department discovers designated uses are not protected.

6.A.2. Netpen Facilities have an Insignificant Impact on Aquatic Life in Puget Sound

EPA's approval of the marine finfish rearing facility provision is expected to have an insignificant impact on the aquatic community of Puget Sound. The number of netpen facilities in Puget Sound total 0.061 square miles (including the 100-foot sediment impact zones) in size. When compared to the total size of Puget Sound – 2,800 square miles – the geographic impact of indirect effects from netpen facilities is expected to be low; i.e., less than 1% of Puget Sound.

The following is an excerpt regarding the total area currently permitted,

> In Washington now about 67.5 total hectares (ha) are leased by companies for commercial salmon net-pens, although not all the leased area is being used (WDNR 2001). The leased area extends to the perimeter of the anchoring system, so the actual area covered by floating structures is much less. The 10 commercial sites currently operational in Puget Sound have a total of 53 ha under lease from the State (ranging in size from 0.8 to 9.7 ha per site), with a total of 8.7 ha permitted for internal pen structures for all Puget Sound salmon farms combined.[22]

The sizes of the eight facilities are listed below in *Table 6-1*.

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[21] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007.

[22] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. "Review of Potential Impacts of Atlantic Salmon Culture on Puget Sound Chinook Salmon and Hood Canal Summer-Run Chum Salmon Evolutionarily Significant Units." NFMFS-NWFSC-53. June 2002. <http://www.nwfsc.noaa.gov/publications/techmemos/tm53/tm53.pdf>

Table 6-1 Permitted Atlantic Salmon Netpen Facilities in Puget Sound.

Facility *	Netpen Area (in feet)	Square Feet	Square Feet of Netpen Area plus 100 foot SIZ	Minimum Water Depth at Site ^
Clam Bay	990 x 185	183,150	310,650	63 feet
Fort Ward	650 x 185	120,250	213,750	35 feet
Orchard Rocks	900 x 185	166,500	285,000	40 feet
Deepwater Bay #1	352 x 190	66,880	131,080	55 feet
Deepwater Bay #2	440 x 190	83,600	156,600	55 feet
Deepwater Bay #3	540 x 190	102,600	185,600	95 feet
Hope Island	440 x 120	52,800	118,800	60 feet
Ediz Hook	900 x 190	171,000	290,000	65 feet
Total		946,780 (8.79 hectares)	1,691,480 (15.7 hectares)	

^ Depths are given at Mean Lower Low Water (MLLW). MLLW is defined as the average height of the lower low waters over a 19-year period. (Ecology)

All facilities owned by Icicle Acquisition Subsidiary, LLC.
Areas determined from Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007. (Modified to change ownership to Icicle Acquisition Subsidiary, LLC).

Total area of Puget Sound: 2,800 square miles[23] or 725,197 hectares.

Total area of netpens with sediment impact zone: 0.061 square miles.

Note: The following types of facilities are not covered by this action: 1) 'Short term' Tribal salmon rearing facilities. These facilities are hatcheries that raise Pacific salmon for three to four months than release them into the wild. There are approximately ten of these facilities. 2) Pacific salmon hatcheries. In 2005, there were 72 of these facilities operated by WDFW and 12 by private industry.[24]

The regulation allows for a 100 foot (approximately 30 meters) sediment impact zone allowed in each direction of the netpen facility. This is consistent with what is allowed in British Columbia and Maine. Similar to a mixing zone, within the SIZ the benthic infaunal criteria is unlikely to be met. An EPA issued NPDES permit in 2002 for Acadia Aquaculture, Inc. in Maine calculated a 30 meter impact zone based on the site's average water depth, average current velocity, prevailing current directions and an established settling rate of feed pellets. Washington NPDES permits for netpen facilities accounted for similar factors in determining the 100 foot sediment impact zone. In addition, NOAA studies indicate that statistically significant increases of nitrogen in the water column do not extend beyond 30 meters from salmon farms in Puget Sound.

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[23] Puget Sound Action Team. About Puget Sound. Accessed online March 7, 2008. <http://www.psat.wa.gov/About_Sound/AboutPS.htm>

[24] Washington State Department of Ecology. "Upland Fin-Fish Hatching and Rearing NPDES General Permit Fact Sheet." June 1, 2005. <http://www.ecy.wa.gov/programs/wq/permits/permit_pdfs/upland_fin_fish/FinFishHatchery_Factsheet.pdf>

Therefore, due to the limited geographical scope of the netpen operations, the designated uses of Puget Sound are protected as a whole.

6.A.3. The Existing Regulatory Framework for Netpen Facilities Provides Protection to Surrounding Habitat and Other Species

EPA's approval of the marine finfish rearing facility provision is based on the understanding that implementation of the sediment quality standards will be conducted through the NPDES permit process. The NPDES permits provide an extensive evaluation to ensure aquatic life in Puget Sound is protected. Ecology reviews and reissues NPDES permits every five years. The current NPDES permits for marine finfish rearing facilities in Puget Sound cover a variety of requirements including the following:[25]

- Monitoring requirements
    - Monitoring schedule
    - Sediment sampling and analysis plan
    - Exceedance monitoring
    - Enhanced sediment quality monitoring
    - Dissolved oxygen profile (in summer)
    - Underwater photographic survey
    - Antibiotic resistance monitoring
- Reporting/Recordkeeping requirements
- Sediment impact zone closure requirements
- Operating requirements
    - General operating requirements
    - Disease control chemical use requirements
- Pollution prevention plan
- Fish release prevention and monitoring plan
- Accidental fish release response plan

In addition to the NPDES permits, several other state and local agencies play an important role in regulating the industry. Washington Department of Fish and Wildlife (WDFW) manages the disease control, salmon stocks and escape risks. WDNR covers the permitting procedures for netpen siting.[26] WDNR requires extensive data, a thorough cost analysis and site specific information to evaluate a location's feasibility as an offshore farm. Although these important regulations do not appear in the marine finfish rearing facility provision itself, they are part of the comprehensive structure that regulates netpens in Washington State.

[25] Washington State Department of Ecology. NPDES Permits for American Gold Seafoods, Inc. 2007. <http://www.ecy.wa.gov/programs/wq/permits/northwest_permits.html>

[26] Washington State Department of Natural Resources. Aquaculture Leasing Statutory and Regulatory Framework. Revised Code of Washington (RCW). Accessed online March 10, 2008. <http://www.dnr.wa.gov/Publications/aqr_aqua_rcw_wacs.pdf>

A brief overview of the regulatory structure for marine finfish rearing facilities follows: [27]

- *Washington State Department of Fish and Wildlife (WDFW)*: manages regulatory authority for commercial aquaculture disease control, escapment and stocks of fish reared in netpens.
- *Washington State Department of Agriculture*: develops regulations with WDFW for commercial aquaculture.
- *Washington State Department of Ecology*: regulates discharges from netpens by issuing NPDES permits that contain operational conditions to protect water quality and sediment standards.
- *Environmental Protection Agency*: approves or disapproves Ecology's water quality and sediment standards.
- *Washington State Department of Natural Resources*: leases aquatic lands for netpen facilities.
- *Counties in Washington State (and sometimes local jurisdictions)*: issues shoreline permits.
- *Tribes of Washington State*: co-manages natural resources in Washington State and have input into aquaculture disease control regulations adopted by WDFW.
- *National Marine Fisheries Service (NMFS)*: administers Endangered Species Act for anadromous salmonids and marine mammals.
- *U.S. Department of Fish and Wildlife (USFWS)*: administers Endangered Species Act for bull trout in Puget Sound.
- *Army Corps of Engineers*: requires netpens to have a Section 404 navigation permit.

In conclusion, there is an extensive multiagency structure to ensure that netpen operations in Puget Sound meet appropriate regulations from site location to site closure.

6.A.4. The Affects on Benthic Communities are Accounted for and Monitored

The marine finfish rearing facility provision focuses primarily on the affects of these facilities on the benthic community in Puget Sound. WAC 173-204-412 grants netpen facilities a sediment impact zone (SIZ) where the sediment quality standards can be exceeded for the size of the facility plus 100 feet on each side of the netpen. The impact of bio-deposits (i.e. fish feces and uneaten food) from netpen operations on benthic communities was identified as a potential risk by NOAA.[28] The risk to the health of benthic communities in Puget Sound near netpen facilities is required to be monitored in WAC 173-204-412. The health of benthic communities near netpen facilities is heavily influenced by the amount of food that settles to the sea floor below netpens and the density of fish in the netpens.

[27] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007.

[28] Nash, C.E. NOAA Fisheries Technical Memorandum. "The Net-pen Salmon Farming Industry in the Pacific Northwest." NFS-NWFSC-49. September 2001. <http://www.nwfsc.noaa.gov/publications/techmemos/tm49/tm49.pdf>

Feeding is typically monitored by facility operations and the NPDES permits state that fish must be feed in a manner which maximizes ingestion, accounts for fish size and digestibility. Rearing density in Washington netpen facilities are from 1 to 1.5 pounds of fish per cubic foot.[29] This density average is about one-half to two-thirds less than typical Atlantic salmon farms.[30]

As a result, benthic monitoring is an appropriate indicator to determine the environmental impact of netpen facilities and NPDES permit compliance. In accordance with WAC 173-204-412(3)(a), new facilities must determine a baseline of benthic infaunal abundance, total organic carbon (TOC) and grain size which is essential for protecting designated uses when a new netpen facility is permitted. Existing facility sediment quality monitoring data must be within a statistically significant range to the reference values for total organic carbon in Puget Sound or the baseline established when the facility was first permitted. These TOC values are listed in Table 1 of WAC173-204-412(3)(b) and appear to based on Ecology's "Puget Sound Ambient Monitoring Program 1992: Marine Sediment Monitoring Task." WDNR required sediment monitoring under the aquatic land leases from 1987 to 1996 and concluded that sediment grain size and water depth were primary in determining an undisturbed benthic infaunal community. In addition, they found that the "redox potential and health of the infaunal community associated with a particular sediment grain size distribution appears well correlated with the level of TOC in the sediments (Striplin Environmental Associates 1996, Goyette and Brooks, 1999)."[31] As a result, TOC reference values appear to be an accurate and applicable manner to monitor benthic infaunal abundance. This is emphasized by NOAA, which states that "TOC is important because fish feces and wasted fish feed contain carbon that demand oxygen during bacterial and food web respiration and assimilation."[32]

The impact on the benthic community can be significantly lowered through facility siting regulations. The major factors that affect solids accumulation are the water current, water depth, loading density, feeding rates, and the length of yearly operations – all of which are accounted for in the NPDES permits. Deep water sites and well-flushed sites can affect the accumulation of organic wastes in the sediment that can alter benthic abundance and diversity.[33] [34] At well-flushed sites with high current, the abundance and

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[29] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007.
[30] American Gold Seafoods, Inc. Accessed online March 4, 2008. <http://www.americangoldseafoods.com/index.html>
[31] Washington State Department of Ecology. "Response to Comments for the 2007 Draft Marine Salmon Netpen NPDES Permits for American Gold Seafoods, Inc." Northwest Regional Office. October 22, 2007. <http://www.ecy.wa.gov/programs/wq/permits/permit_pdfs/american_gold/clam_bay/AmGoldSea_ResponsivenessSummary.pdf>
[32] Rensel, J.E. and J.R.M. Forster. "Beneficial Environmental Effects of Marine Finfish Mariculture." NOAA. 2007.
[33] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[34] Washington Department of Natural Resources. Technical Report. 1999.

diversity of benthic organisms is positively correlated with organic carbon, which suggests netpen facilities could even stimulate benthic communities.[35]

If netpen facilities do not meet the baseline or reference values, additional source control and NPDES permitting addresses non-compliance. WAC 173-204-412(4)(a) makes the requirements more stringent for facilities that are authorized a sediment impact zone beyond 100 feet by applying additional criteria for benthic abundance. The benthic abundance criteria, WAC 173-204-420 (3)(c)(iii), requires that sediment impact zone maximum biological effects level are established as that level below which any two of the biological tests in any combination exceed the criteria of WAC 173-204-320(3), or one of the following biological test determinations is made:

- the test sediment has less than 50% of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta; or
- the test sediment abundances are statistically different (t test, $p \leq 0.05$) from the reference sediment abundances.

As explained above, benthic abundance monitoring is the appropriate method for determining the impact of sediment quality by netpen facilities. Extensive monitoring is required in NPDES permits for netpen facilities to ensure benthic impacts do not extend beyond the authorized sediment impact zone.

Finally, there is no evidence available that allowing impact to small areas of benthic communities adversely affects any of the listed or threatened species in this Biological Evaluation. In two NOAA technical memorandums[36] assessing the risks of Atlantic salmon rearing facilities on the aquatic environment of Puget Sound, no mention is made of the potential of benthic infaunal abundance to be a risk to endangered species, including Pacific salmon. NOAA assigned the possibility of changes in the epifaunal community as carrying a low risk, stating that epifuanal communities have been studied in detail and one study that was conducted for ten years revealed significant numbers of fish, shrimp, and other megafuana habituated the site.[37] In addition, NOAA claims elsewhere that there may be beneficial environmental effects associated with netpen farming in Puget Sound. For example, a NOAA study from 2004-2006 found that netpens in Puget Sound support a diverse group of over 100 species of seaweeds and invertebrates, which are important for the local food web and can be considered a beneficial effect of fish farming.[38]

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[35] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[36] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001. Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.
[37] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[38] Rensel, J.E. and J.R.M. Forster. “Beneficial Environmental Effects of Marine Finfish Mariculture.” Prepared for NOAA National Marine Fisheries Service. NOAA Award # NA04OAR4170130. July 22, 2007.

6.A.5. The Closure Procedures of Netpen Facilities Ensure the Aquatic Environment is Restored to Baseline Levels

The goal of closure requirements is to return the sediment quality to baseline levels prior to a netpen facility's operation at a given location.[39] Closure requirements under WAC 173-204-412(3)(e) mitigate for sediment impacts after a netpen facility is no longer operational. Finfish rearing facilities typically do not have a toxic impact on sediments since the main sediment impact is caused by organic materials from uneaten fish food and fish feces. As a result, sediment quality standards for netpen facilities are based on total organic carbon values, which are an appropriate measurement to determine effects of the accumulation of organic materials on benthic infaunal abundance. These values are found in Table 1 at WAC 173-204-412(3)(b).

There are two main concerns that could affect closure regarding heavy metals in the sediment below netpens, copper, which is used in marine anti-fouling compounds and zinc from fish feed.[40] Regarding copper, WDNR noted that chemical anti-fouling agents were not used in Washington, eliminating the associated risk related to copper.[41] Zinc is considered an essential mineral element for salmon nutrition. However, its concentration in dry fish feed is routinely tested and the results have been negative for metals.[42] Furthermore, monitoring required by a NDPES permit for the Ediz Hook location (which is representative of all facilities) found all copper and zinc data were below cleanup screening levels and sediment quality standards.[43] Therefore, closure and cleanup is generally straightforward since toxics are not typically present in the sediment below the facilities.

6.A.6. The Indirect Effects of Netpen Facilities Carry a Low Risk

There are several other indirect effects which have been identified and commonly associated with netpen facilities. Although these indirect effects are admittedly problems in other areas of the world, they cannot be readily applied to Washington's situation due to the regulatory framework, site location restrictions, small quantity of netpen facilities, and geographical features of Puget Sound. While these could be considered outside the scope of WAC 173-204-412, reports have indicated these indirect effects have a low risk and are therefore addressed. The indirect effects include:

Dissolved oxygen / Phytoplankton blooms

Dissolved oxygen monitoring is required in the NPDES permit for marine netpen facilities. NOAA assigned low risk to the physiological effect of low dissolved oxygen on other biota in the water column. Since salmon are sensitive to dissolved oxygen, a localized dissolved oxygen effect would first show up in the farmed salmon.[44] Another

[39] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007.
[40] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[41] Washington Department of Natural Resources. Technical Report. 1999.
[42] Washington State Department of Ecology. Response to Comments for the 2007 Netpen Draft NPDES Permits. 2007.
[43] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007.
[44] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.

common concern related to netpen facilities is nitrate induced organic enrichment which may result in excessive phytoplankton growths or blooms in nutrient sensitive waters. In 1986, Ecology rated all subareas of Puget Sound for nutrient sensitivity and none of the commercial netpens are located in these waters.[45] There is no evidence of netpen facilities causing blooms in the Puget Sound area.[46] Furthermore, several studies have concluded that there is no measurable effect of phytoplankton production near salmon farms in Puget Sound.[47] NOAA states the likelihood of the enhancement of a harmful algal bloom caused by the inorganic nutrients discharged from netpen facilities in Puget Sound to be highly unlikely due the natural atmospheric and geographical parameters, such as limited light availability due to the higher latitudes of the Pacific Northwest.[48]

Disease transmission /Antibacterial usage / Sea Lice

The increased incidence of disease among wild fish is considered a low risk by NOAA and there have been few documented cases of this actually occurring. NOAA states, "the specific diseases and their prevalence in Atlantic salmon stocks cultured in net pens in Puget Sound are not shown to be any different than those of the more numerous cultured stocks of Pacific salmon in hatcheries, which in turn are not known to have a high risk for infecting wild salmonids." [49] Furthermore, WDFW requires fish growers to report the presence of certain listed pathogens, permits the transfer of fish into netpens and requires review of the stock disease history.[50] Also, WDNR states that there is no risk of farmed fish transferring disease to shellfish since fish pathogens are distinct from invertebrate pathogens.[51] NOAA also states that there is little risk that existing Atlantic salmon stocks will be a vector for the introduction of an exotic pathogen to Puget Sound.[52]

Antibiotic usage in netpen facilities is regulated by the US Food and Drug Administration (USFDA) and WDFW. Antibacterial usage has been decreasing according to monitoring required by the NPDES permits.[53] NOAA notes that "there is little risk that the development of an antibiotic-resistant bacteria in netpen salmon farms or Atlantic salmon freshwater hatcheries will impact native salmonids, as similar antibiotic resistance often observed in Pacific salmon hatcheries has not shown to have a negative impact on wild salmon." Some of these compounds have been used in Washington for 40 years without adverse impacts.[54] In addition, "case studies show that some of these compounds can be detected in sediments close to the perimeter of netpen farms, but the levels resulting from

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[45] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007.
[46] Washington Department of Natural Resources. Technical Report. 1999.
[47] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.
[48] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[49] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[50] Washington State Department of Ecology. Response to Comments for the 2007 Netpen Draft NPDES Permits. 2007.
[51] Washington Department of Natural Resources. Technical Report. 1999.
[52] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.
[53] Washington State Department of Ecology. Response to Comments for the 2007 Netpen Draft NPDES Permits. 2007.
[54] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.

their authorized use do not show significant widespread adverse affects on either pelagic or benthic resources."[55]

Sea lice refer to several species of parasitic copepods found in marine environments. The most common species of sea lice reported on wild and farmed salmon are *Lepeophtheirus salmonis*, which infects salmonids only, and *Caligus clemensi* or *Caligus elongatus*, which infects a broad range of fish species including salmonids.[56] The role of Atlantic salmon reared in netpens as a source of infective sea lice to wild salmon has been studied for decades in Europe with significant disagreement in research findings.[57]

In general, there is little agreement about the factors that influence sea lice propagation and transmission from netpen operations to wild salmon. Studies in Ireland[58] and in British Columbia[59] have attempted to link higher infestation rates of wild salmonids to areas where farmed salmon are present. Others have challenged the conclusions in these reports through additional research.[60] Many risk factors potentially influence sea lice abundance. These risk factors, which contribute variability to sea lice incidence and lethality, include geographic location, channel morphology and currents, salinity and temperature, presence of large and healthy runs, and the size of wild salmon populations.[61] In addition, the density of fish in the netpens may also be a contributing factor to sea lice infestation. For example, one study found that fewer Atlantic salmon resulted in lower abundance and prevalence of *L. salmonis* on juvenile pink salmon and chum near salmon farms.[62]

Temperature and salinity have been the topic of extensive research as they relate to sea lice life stages which, in turn, determine abundance. Most research indicates that sea lice infections increase in years where temperatures of seawater are higher and salinity is higher.[63] However, studies looking at sea lice abundance and salinity/temperature

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[55] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[56] Undated. "Sea Lice Fact Sheet." Aquaculture Association of Canada. http://www.aquacultureassociation.ca/sites/default/files/Sea%20Lice%20Fact%20Sheet.pdf
[57] Brooks, Kenneth M. "An Assessment of the Threat to Pink Salmon (*Oncorhynchus gorbuscha*) Runs in the Broughton Archipelago of British Columbia, Canada Posed by Sea Lice (*Lepeophtheirus salmonis*) Infections Originating on Cultured Atlantic Salmon (*Salmo salar*)." Aquatic Environmental Sciences. June 1, 2003.
[58] Tully, O., Gargan, P., Poole, W.R., and Whelan, K.F. 1999. "Spatial and temporal variation in the infestation of sea trout (*Salmo trutta* L.) by the Caligid Copepod *Lepeophtheirus salmonis* (Kroyer) in relation to sources of infection in Ireland." Parasitology 119:41
[59] Krkosek, M., Ford, J.S., Morton, A., Lele, S., Myers, R.A., and Lewis, M.A. 2007. "Declining Wild salmon populations in relation to parasites from farm salmon." Science. 318: 1772-1775
[60] Brooks, K.M., and Jones, S.R.M. 2008. "Perspectives on pink salmon and sea lice: scientific evidence fails to support the extinction hypothesis." Reviews in Fisheries Science. 16(4): 403-412
[61] Gallaugher, Patricia, Jennifer Penikett and Laurie Wood. "Scientists' Roundtable on Sea Lice and Salmon in the Broughton Archipelago Area of British Columbia." Conveners Report. November 18, 2004.
[62] Orr, Craig. "Estimated Sea Louse Egg Production from Marine Harvest Canada Farmed Atlantic Salmon in the Broughton Archipelago, British Columbia, 2003-2004." North American Journal of Fisheries Management 2007. Vol. 27; p. 187-197.
[63] Brooks, Kenneth M. "A Comparison of Some Environmental Costs Associated with Netpen Culture of Fish with Some Other Forms of Food Production." Aquatic Environmental Sciences. <http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5064654>

interactions have found varying results. On the one hand, Saksida found that factors such as the age of the salmon populations, location of farms and time of year had a significant effect on abundance, while temperature and salinity did not.[64] On the other hand, Boxaspen found geographical influences on the prevalence of sea lice to be unclear, but presumed temperature and salinity to be important factors.[65] A study done off the Norwegian Skagerrak coast found that salinity was statistically related to the presence of *C. elongates* and *L. salmonis*, but temperature appeared to be less important for the abundance of lice.[66] Brooks concluded that Krkosek failed to adequately account for salinity and temperature in drawing relationships between sea lice transmission and farmed fish in British Columbia.[67] [68]

Salinity in particular has often been linked to sea lice survival and abundance. Brooks recaps the commonly cited literature: "Wadsworth (1999) summarized information indicating that adults die rapidly at salinities less than 12 parts per thousand and that while eggs hatch successfully at salinities as low as 15 parts per thousand, survival was nil. Survival improved at 20-25 parts per thousand, but that development to the copepodid stage was negligible. Complete development to the copepodid stage was only achieved at salinities greater than 30 parts per thousand and even then it varied greatly." This is consistent with findings by Bricknell et al., which found that survival of free-swimming copepodids is severely reduced below 29 parts per thousand.[69] Brooks asserts that the research done in the Broughton Archipelago may be associated with salinity fluctuations and their relationship with rainfall/snowmelt in the spring and glacier melt in the summer and fall.[70] In a recent concurrence letter, NMFS stated that although the salinity levels of Puget Sound vary, the upper surface layers of Puget Sound are well below 25 parts per thousand during most of the year due to the many rivers and streams entering this large estuary.[71] NMFS believes this explains why the levels of sea lice have

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[64] Saksida, S, et al. "Differences in *Lepeophtheirus salmonis* Abundance Levels on Atlantic Salmon Farms in the Broughton Archipelago, British Columbia, Canada. Journal of Fish Diseases 2007. Vol. 30; p. 357-366.

[65] Boxaspen, Karin. "A Review of the Biology and Genetics of Sea Lice." ICES Journal of Marine Science 2006. Vol. 63; p. 1304-1316.

[66] Heuch, P.A. et al. "Salinity and Temperature Effects on Sea Lice Over-Wintering on Sea Trout (*Salmo trutta*) in Coastal Areas of the Skagerrak." Journal of the Marine Biological Association of the UK 2002. Vol 82; p. 887-892.

[67] Brooks, K.M. 2005. "The effects of water temperature, salinity, and currents on the survival and distribution of the infective copepod stage of sea lice (*Lepeophtheirus salmonis*) originating on Atlantic salmon farms in the Broughton Archipelago of British Columbia, Canada." Reviews in Fisheries Science 13:177-204

[68] Brooks, K.M. and Stucchi, D.J. 2006. "The effects of water temperature, salinity and currents on the survival and distribution of the infective copepodid stage of the salmon louse (*Lepeophtheirus salmonis*) origination on the Atlantic salmon farms in the Broughton Archipelago, British Columbia, Canada (Brooks, 2005) – a response to the rebuttal of Krkosek at al. (2005)." Reviews in Fisheries Science 14:13-23

[69] Bricknell, I.R., Dalesman, S.J., O'Shea, B.O, Pert, C.C., Luntz, A.J.M., 2006. "Effect of Environmental salinity on sea lice *Lepeophtheirus salmonis* settlement success," Diseases of Aquatic Organisms 71:201-212.

[70] Brooks, Kenneth M. Aquatic Environmental Sciences. June 1, 2003.

[71] March 16, 2010. Letter from Barry A. Thom, Acting Regional Administrator, Northwest Region, NMFS to Michelle Walker, Chief, Seattle Regulatory Branch, U.S. Army Corps of Engineers Re: ESA and EFH Consultation for American Gold Seafoods Net-Pen Array Relocation.

been much lower in Puget Sound compared to other regions of the world.[72] Areas outside of Puget Sound with high concentrations of netpens typically have higher salinity levels.

Despite the large amount of research on the variables that cause sea lice outbreaks, uncertainty remains about the relationship between temperature, salinity, and the abundance of sea lice. As evidenced by the research summarized above, temperature and salinity are likely influencing factors but many other variables may also affect the abundance of sea lice. Considered in isolation from other variables, historical temperature and salinity data from EPA's STORET database[73] suggest that Puget Sound may be capable of supporting sea lice. However, the temperature and salinity conditions of Puget Sound, combined with other factors that may affect sea lice abundance (e.g., geography, currents, population size, etc.) appear to have allowed Puget Sound to avoid the sea lice issues that other parts of the world with netpen operations have experienced. This conclusion is supported by the observation that sea lice have not been a significant problem in Puget Sound, even during drought years when salinity has been higher.[74] In general, the wide range of data and research appear to be inconclusive in developing detailed and definitive trends among the many potential variables that can contribute to sea lice outbreaks. Most importantly, there is no empirical evidence that sea lice have been a problem in Puget Sound and therefore any effects on listed species would be discountable. NMFS confirms this by stating that there have been no known episodes of sea lice outbreaks in Puget Sound affecting wild Pacific salmon populations indigenous to Puget Sound.[75]

To ensure sea lice does not become problematic in Puget Sound, the implementation procedures required by Ecology for NPDES permitting account for sea lice. In writing the permits, Ecology conducted literature reviews and consulted with WDFW to confirm that the sea lice problems occurring in British Columbia are not occurring in Puget Sound. Ecology will follow recently funded studies on sea lice monitoring in the Broughton Archipelago; and Ecology will also collaborate with WDFW to monitor sea lice at the currently located netpen facilities as required by the NPDES permits.[76] Personal communication between EPA and Ecology staff confirmed that the facilities Ecology inspected had current sea lice monitoring logs which are designed to record any increase in occurrence, infestations, outbreaks or situations where sea lice appear to be impacting fish health. Upon inspection, these logs did not indicate increases above

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[72] Communication with Kevin Amos, NOAA Fisheries, National Aquatic Animal Health Coordinator. 2009. (Cited in NMFS concurrence letter dated March 16, 2010.)
[73] September 5, 2008. Amended Complaint Document. Exhibits E and F. *Wild Fish Conservancy v. U.S. EPA*, 08-cv-00156 (W.D. Wash).
[74] Washington State Department of Ecology. "Response to Comments for the 2007 Draft Marine Salmon Netpen NPDES Permits for American Gold Seafoods, Inc." Northwest Regional Office. October 22, 2007.
[75] Communication with Kevin Amos, NOAA Fisheries, National Aquatic Animal Health Coordinator. 2009. (Cited in NMFS concurrence letter dated March 16, 2010.)
[76] Ibid.

normal levels of sea lice which would trigger NPDES permit requirements to report these findings to Ecology and WDFW within one week.[77]
EPA staff also conducted a review of 217 publications relating to marine finfish rearing, collected by the Wild Fish Conservancy ("WFC") and submitted to NMFS on June 12, 2008.[78] EPA found that the large majority of the publications were not specifically relevant to marine finfish rearing in Puget Sound. In fact, one of the few publications specific to Washington state, is consistent with the information provided in this BE supporting EPA's determinations.[79] None of the information presented in the publications clearly documented that biotic effects of netpens on benthic sediments have the potential to adversely affect salmonids or other threatened and endangered species in Puget Sound.[80]

EPA staff also reviewed additional materials that were submitted by WFC (certain legal exhibits) and NMFS (discussion of exhibits by a staff scientist) in the course of prior litigation relating to the SMS.[81] The exhibits submitted by WFC included photographs of fish with sea lice and a chart that WFC obtained from WDFW, apparently documenting sea lice incidence at an Atlantic salmon fish processing plant. After reviewing the exhibits and associated NMFS discussion, EPA does not find these exhibits supply relevant scientific information linking sea lice and netpen operations in Puget Sound. Specifically, the NMFS discussion noted that the photos do not constitute scientific evidence of sea lice incidence or transmission in Puget Sound. Furthermore, and consistent with NMFS' discussion, EPA does not find that the submitted chart documents an elevated incidence of sea lice in farmed salmon.

Escape / Hybridization / Competition
Since 2000, there has been only one escapement event in Puget Sound since best management practices have helped prevent the unintentional release of Atlantic salmon from netpens. During the last permit cycle, all eight netpen sites in Puget Sound installed fish containment nets with a heavier nylon material. Therefore, the potential for another escape event has been greatly reduced by the actions of the permittee.[82]

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[77] Personal communication between Matthew Szelag, EPA and Lori Levander, Department of Ecology, November 21, 2008.
[78] NMFS notified EPA of this letter and provided them the CD with the list of publications on June 12, 2008. Personal communication between Matthew Szelag, EPA and Matt Longenbaugh, NMFS, June 12, 2008.
[79] Rensel. Jack. J.E. Undated powerpoint slides. "Water Quality and Sediment Impact Management of Finfish Net Pens in Washington State."
[80] This analysis is provided in the following document and enclosure summarizing each publication. September 17, 2008. Memorandum from Matthew Szelag, EPA, to the Record, Re: Analysis of Additional Publications Provided by Wild Fish Conservancy (WFC) to National Marine Fisheries Service and U.S. Fish and Wildlife Service (the Services) on June 12, 2008.
[81] Exhibits filed with "Plaintiff's Motion to Complete and Supplement the Administrative Record," July 2, 2009. Declaration of Kevin H. Amos, filed with "Federal Defendants' Opposition to Plaintiff's Motion to Supplement the Administrative Record," August 21, 2009. Both documents filed in *Wild Fish Conservancy v. U.S. EPA*, 08-cv-00156 (W.D. Wash).
[82] Washington State Department of Ecology. Response to Comments for the 2007 Netpen Draft NPDES Permits. 2007.

NOAA has found that there is little risk that escaped Atlantic salmon will hybridize with Pacific salmon.[83] In addition, there is no evidence of Atlantic salmon - Pacific salmon hybrids in nature.[84] WDFW states that if such a rare event should occur in the wild, the offspring would be incapable of reproduction.[85]

With regard to competition between escaped Atlantic salmon to native wild salmon, NOAA has determined low to little risk for the following: [86] [87]

- The risk that escaped Atlantic salmon will compete with wild salmon for food or habitat is low, considering their well-known inability to succeed away from their historic range.
- There is little risk that Atlantic salmon will colonize habitats in the Puget Sound Chinook salmon and Hood Canal summer-run chum salmon ESUs.
- There is little risk that escaped Atlantic salmon will prey on Pacific salmon.

These findings of low risk are also similarly supported by WDFW.[88]

6.A.7. Puget Sound Salmon Recovery Plan

Volume I. (page 366)
Volume I of the Puget Sound Salmon Recovery Plan contains the following statement about netpen operations.

"Concerns associated with the net pens are the potential release of non-native species and water quality impacts." (pg. 366)

This statement summarizes a potential issue with netpens. EPA is aware of these issues and has addressed them in this BE. Release of non-native species was addressed in this BE, in section 6.A.6. EPA has also reviewed several sources that address escape of farmed salmon, including NOAA's technical memorandums, which determine that escape is a low risk to wild salmon.[89] The Salmon Recovery Plan does not document any adverse effect on chinook salmon resulting from escaped Atlantic salmon in Washington or elsewhere.[90] Water quality impacts, such as those to aquatic life and benthic species, are addressed throughout the BE since these are the primary rationale for developing sediment management standards and the associated regulatory language concerning marine finfish operations within those standards. These are discussed in further detail in section 6.A.2. and 6.A.4 along with indirect effects to water quality such as dissolved oxygen and phytoplankton blooms in section 6.A.6.

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[83] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.
[84] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[85] Washington State Department of Fish and Wildlife. Fact Sheet. 2001.
[86] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001.
[87] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.
[88] Washington State Department of Fish and Wildlife. Fact Sheet. 2001.
[89] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002. pages 65-66.
[90] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001. page 90.

Volume II. Nearshore chapter. June 28, 2005. (page 4-28, 4-30)
The nearshore chapter of the recovery plan states that commercial netpen salmon farms are a possible activity that may contribute to the alteration of biological populations and communities.

"Stressor: alteration of biological populations, communities
Examples of activities contributing to this stressor: aquaculture (net pens)

Working hypotheses
1. poor finfish aquaculture practices can negatively affect juvenile salmon through increased water quality degradation and introduction of diseases to wild populations.
…
4. poor aquaculture practices can negatively affect juvenile salmon through introduction of new aquatic nuisance species and increased competition for a limited prey base in the case of escapes from net pens."

Table on page 4-34: Effects of alteration of biological populations and communities on ecosystems and salmon and bull trout functions

Activities	*Effects on nearshore and marine ecosystem processes and habitats*	*Hypothesized effects on salmon and bull trout functions*
Aquaculture (net pens)	• *introduction of diseases* • *introduction of non-native species* • *possible increased nutrient loading contributing to eutrophication*	• *increased susceptibility to disease mortality* • *increased competition from escaped Atlantic salmon for breeding and rearing habitat* • *potential for localized hypoxia mortality*

The nearshore chapter discusses some of the potential stressors to listed salmon from poor aquaculture practice. The nearshore chapter also states general concerns from poor aquaculture practices, including water quality, disease, competition and escapement. As discussed in this BE in section 6.A.3., multiple agencies regulate netpens in Puget Sound. The potential effects listed in this section of the recovery plan are also addressed in the NPDES permits and discussed throughout this BE. While the Salmon Recovery Plan speculates as to the potential effects of poor aquaculture practices on listed species, there is no evidence in the Salmon Recovery Plan or elsewhere that these effects are occurring in Puget Sound.

In addition, there is a reference in nearshore chapter on page 4-30 to accidental release of fish from a netpen in 1997 and a discharge of visible solids in 1997.

"Fish can escape from aquaculture facilities and become an ecological problem. In the case of salmon farms, fish can escape in small numbers from "operational leakage," and in large numbers from damage to pens due to storms, human error, and so on. Examples

of big escapes include an episode of 300,000 salmon escape from a Washington farm in an accident in 1997. (Center for Health and the Global Environment).

Four salmon net pens in the state of Washington in 1997 discharged 93 percent of the total amount of visible solids into Puget Sound. (Center for Health and the Global Environment). Discharges from salmon farms can also contain antibiotics and other chemicals that are used to kill salmon parasites."

EPA addresses these concerns in more detail in section 6.A.6. of this BE which provides details on recent improvements which lower the risk of escape and increase regulatory monitoring. During the last permit cycle, all eight netpen sites in Puget Sound installed fish containment nets with a heavier nylon material. Therefore, the potential for another escape event has been greatly reduced by the actions of the permittee.[91] Escape is also addressed in the NOAA technical memorandums, which determine that escape is a low risk to wild salmon.[92] There is no documented adverse effect on chinook salmon resulting from escaped Atlantic salmon in Washington or elsewhere.[93]

Regarding the statement that "*in 1997 discharged 93 percent of the total amount of visible solids into Puget Sound*," Ecology addresses this assertion on page 31 of their response to comments document.[94] Peer reviewed documents, such as those by Waknitz F.W., et al., have stated that netpen operations present a low risk to water quality due to facility siting at appropriate depths with the necessary flushing capacity. The quotation above is from a non-peer reviewed, personal communication that draws inferences between netpen waste and sewage treatment plans with a focus on total suspended solids, not settleable solids which the sediment management standards are designed to regulate.

In addition, there have been improvements in fish feed and feeding technologies which are now commonly used to monitor feeding behavior in efforts to minimize losses of uneaten feed from netpens. These practices have reduced the loss of feed to the environment to 5% or less, a figure significantly lower than the 20-30% loss estimated in some aquaculture models.[95] Waknitz, F.W., et al. state that these organic discharges from Puget Sound netpens do not seem likely to adversely affect threatened salmonids.[96] In addition, the major factors that affect solids accumulation are water current, water depth, fish density, feeding rates, and the length of yearly operations – all of which are accounted for in the NPDES permits. Therefore, these potential effects were found to be insignificant and discountable.

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[91] Washington State Department of Ecology. Response to Comments for the 2007 Netpen Draft NPDES Permits. 2007.
[92] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002. pages 65-66.
[93] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001. page 90.
[94] Washington State Department of Ecology. Response to Comments for the 2007 Netpen Draft NPDES Permits. 2007.
[95] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001. page 37.
[96] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002. pages 52-53.

Volume II. East Kitsap Watershed Chapter. 2005. (page 78)
The chapter on the east Kitsap watershed makes the following statement regarding netpen facilities:

"Netpen facilities: There are salmonid netpen facilities at several locations, including Manchester and at the southern end of Bainbridge Island. Netpen installations are known to affect sediment quality due to shading, and due to accumulation of excess food and fish feces that accumulate on the bottom in the vicinity of the netpen."

This statement discusses the sediment impacts from netpens in general, and does not establish that existing netpen operations in Puget Sound are likely to adversely affect listed salmonids. See the last paragraph above which explains that these potential effects were found to be insignificant and discountable.

6.A.8. Southern Resident Killer Whale Recovery Plan

The following three paragraphs (on pages II-84 and II-85) in the southern resident killer whale recovery pan discuss Atlantic salmon aquaculture.

"Aquaculture of Atlantic salmon. The intensive commercial farming of Atlantic salmon (Salmo salar) and smaller amounts of Chinook and coho salmon in marine netpens in British Columbia and Washington represents an additional potential, but highly debated, threat to wild Pacific salmon (Gallagher and Orr 2000, Gardner and Peterson 2003). The region's industry has grown dramatically in the past several decades and produces an estimated 50 million kg of salmon annually, about 90 percent of which comes from British Columbia (Amos and Appleby 1999). Licensed net-pen operations currently occur at about 126 sites in British Columbia and eight sites in Washington (A. Thomson, pers. comm.; J. Kerwin, pers. comm.). Concerns center primarily over 1) marine net-penned Atlantic salmon transmitting infectious diseases to adjoining wild salmon populations and 2) escaped Atlantic salmon becoming established in the wild and competing with, preying on, or interbreeding with wild Pacific salmon. Current evidence suggests that these concerns are largely unfounded in Washington and that Atlantic salmon aquaculture poses minimal risk to wild salmon stocks there (Nash 2001, Waknitz et al. 2002; J. Kerwin, pers. comm.). Escapes of penned Atlantic salmon exceeded 100,000 fish per year in the late 1990s in Washington (Amos and Appleby 1999), but improved management of salmon farms since then has greatly reduced this problem, resulting in far fewer free-ranging Atlantic salmon in the state's waters (WDFW 2003). The situation in British Columbia is far more uncertain because of the larger size of the industry (Gardner and Peterson 2003), which has resulted in larger numbers of escapes (mean = 47,150 fish per year from 1994-2002) and regular capture of free-ranging fish (mean = 1,713 fish reported per year from 1992-2002)(Morton and Volpe 2002, DFO 2003). Small numbers of naturally produced juvenile Atlantic salmon have been recorded in three rivers on Vancouver Island (e.g., Volpe 2000), but self-sustaining populations are not known to occur anywhere in the province (A. Thomson, pers. comm.). However, limitations in stream monitoring make it difficult to rule out the absence of additional populations (Gardner and Peterson 2003).

There is compelling evidence that sea lice (Lepeophtheirus salmonis) are transmitted from salmon farms to wild salmon (Krkošek et al. 2005), but the severity of impacts to wild fish remains uncertain (Gardner and Peterson 2003). Sea lice from farms have been linked to a decline of wild pink salmon populations in British Columbia's Broughton Archipelago (Morton et al. 2004), although this finding has been disputed and may simply reflect a normal downward fluctuation in the populations.

Salmon farms in British Columbia are concentrated along the central coast and on west-central Vancouver Island, and are projected to continue expanding in number in the future. The eight farms in Washington are located at Ediz Hook (Clallam County), Cypress and Hope islands (Skagit County), and off southern Bainbridge Island (Kitsap County)."

The southern resident killer whale recovery plan summarizes several issues that have already been addressed in this BE, primarily in section 6.A.6., with support from the NOAA technical memorandums.[97] These include disease transfer, escape and the overall size of netpen operations. In writing the permits, Ecology conducted literature reviews and consulted with WDFW to confirm that the sea lice problems occurring in British Columbia are not occurring in Puget Sound. During the last permit cycle, all eight netpen sites in Puget Sound installed fish containment nets with a heavier nylon material. Therefore, the potential for another escape event has been greatly reduced by the actions of the permittee.[98] In addition, the scope of netpen operations in Washington is far less than British Columbia. The recovery plan differentiates between the circumstances in Puget Sound and British Columbia, and the plan itself concludes that Washington operations have improved fish-farming techniques. The recovery plan indicates that Atlantic salmon aquaculture poses "minimal risk to wild salmon stocks" in Washington and that comparisons by analogy to British Columbia are "largely unfounded."

6.B. ANALYSIS OF EFFECTS ON FISH SPECIES

Salmon Evaluation

Based on the above rationale, EPA has concluded its approval of WAC 173-204-412 would not adversely affect listed fish species since the effects are considered insignificant. This includes the analysis in this BE that determines:

- NOAA technical memorandums determine beneficial affects and low potential for negative affects.
- The designated uses of Puget Sound are protected.
- Netpen facilities have an insignificant impact on aquatic life in Puget Sound.
- The existing regulatory framework for netpens provides protection to surrounding habitat and other species.
- The effects on the benthic community are accounted for and monitored.

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[97] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001. Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.

[98] Washington State Department of Ecology. Response to Comments for the 2007 Netpen Draft NPDES Permits. 2007.

- The closure procedures of netpen facilities ensure the aquatic environment is restored to baseline levels.
- The indirect effects of netpen facilities carry a low risk.

Insignificant effects relate to the size of the impact and do not reach a scale where take occurs.[99] EPA recognizes that a small amount of individual listed fish in the vicinity of netpen facilities may be affected. Therefore, EPA's action may have an insignificant impact on the following:

- *Sub-adult salmonid consumption of benthic organisms near netpen facilities.* This impact is expected to be insignificant since facility siting by WDNR is restricted to deeper waters to limit negative impact on benthic communities. In addition, when comparing the impact of Puget Sound netpen facilities to seafood processing waste in Alaska, NOAA states that "the markedly smaller organic discharges from Puget Sound salmon farms do not seem likely to adversely affect threatened salmonids in Puget Sound."[100]

- *Juvenile nearshore habitat.* Since sites permitted for Atlantic salmon farms are restricted to deeper waters to minimize benthic community impacts, the effects on juvenile nearshore habitat are also expected to be insignificant. For example, current netpen locations do not overlap with the designated critical habitat of the Hood Canal chum salmon.

- *Migration corridors of listed salmonids.* This impact is considered to be low since the number and size of netpens in Puget Sound is insignificant. NOAA technical memorandums do not mention any migration concerns related to the location of netpen facilities.

The analysis in this BE with the support of NOAA technical memorandums, provides that the marine finfish rearing facility provision is protective of designated uses, including those related to wild salmon in Puget Sound, and netpen facilities carry an insignificant risk of negatively affecting wild salmon. As a result, EPA has concluded that its approval of WAC 173-204-412 **may affect, but is not likely to adversely affect** the following listed species:

Oncorhynchus tshawytscha	Chinook Salmon (Puget Sound ESU)
Oncorhynchus keta	Chum Salmon (Hood Canal summer-run ESU)
Oncorhynchus mykiss	Steelhead (Puget Sound, DPS)

Rockfish Evaluation

On April 27, 2010, NMFS listed the boccacio rockfish as endangered, the canary rockfish

[99] U.S. Fish and Wildlife Service and National Marine Fisheries. "Consultation Handbook: *Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act*." March 1998. <http://www.fws.gov/endangered/pdfs/Sec7/handbook/CH1-3.PDF>

[100] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.

as threatened and the yelloweye rockfish as threatened. These listings took effect on July 27, 2010.[101]
In general, the three rockfish species inhabit very deep waters with rocky bottoms in deep benthic habitats.[102] Yelloweye, canary and bocaccio rockfish utilize deepwater habitats primarily around the San Juan Islands, Haro Strait, a few isolated outcroppings and ridges in the Strait of Juan de Fuca, and a few locations in the South Sound.[103] Juveniles are generally found in the shallower end of these ranges. The netpens in Puget Sound are not located at areas with such water depths and there is little overlap between these specific locations and the existing netpen operations. Although the water depth varies under the area of each individual netpen, the table below contains the estimated maximum water depth below each netpen. The maximum depth below any of the netpens is approximately 162 feet at the Ediz Hook netpen site. The remaining seven netpens are located over shallower water depths. Since the three rockfish species are deepwater species, they primarily inhabit water depths of 160 feet (bocaccio, canary) or 300 feet (yelloweye) and deeper. Thus, there is expected to be little overlap between the existing netpen facilities and primary rockfish habitat.

Depths and Netpen Sizes[104] [105]

Facility	Estimated Maximum Water Depth Below Netpen	Length of Aggregate Netpen Rearing Area	Width of Aggregate Netpen Rearing Area
Clam Bay	91 feet	990 feet	185 feet
Fort Ward[106]	41 feet	650 feet	185 feet
Orchard Rocks	74 feet	900 feet	185 feet
Deepwater Bay #1	96 feet	352 feet	190 feet
Deepwater Bay #2	84 feet	440 feet	190 feet
Deepwater Bay #3	102 feet	540 feet	190 feet
Hope Island	90 feet	440 feet	120 feet
Ediz Hook	162 feet	900 feet	190 feet

Bocaccio is a deepwater rockfish fish species typically found at depths between 160-820 feet,[107] which is deeper, overall, than the waters under the netpens. In addition, bocaccio

[101] National Marine Fisheries Service. Northwest Regional Office. Puget Sound Rockfish Endangered Species Act Listing. http://www.nwr.noaa.gov/Other-Marine-Species/Puget-Sound-Marine-Fishes/ESA-PS-Rockfish.cfm
[102] Palsson, Wayne A. et al. "The Biology and Assessment of Rockfishes in Puget Sound." Washington Department of Fish and Wildlife. September 2009. http://wdfw.wa.gov/publications/00926/wdfw00926.pdf
[103] Palsson, Wayne A. et al. "The Biology and Assessment of Rockfishes in Puget Sound." Washington Department of Fish and Wildlife. September 2009. http://wdfw.wa.gov/publications/00926/wdfw00926.pdf
[104] Netpen area determined from Washington State Department of Ecology. NPDES Permit Factsheets for Icicle Acquisition Subsidiary LLC. http://www.ecy.wa.gov/programs/wq/permits/northwest_permits.html#I
[105] NOAA Office of Coast Survey. Pacific Coast Nautical Chart On-Line Viewer. http://www.charts.noaa.gov/OnLineViewer/PacificCoastViewerTable.shtml
[106] On May 27, 2010, the Kitsap County Hearing approved a request for a Shoreline Substantial Development Permit and Shoreline Conditional Use Permit to relocate the Fort Ward netpen structure to a new location in Clam Bay. http://www.kitsapgov.com/dcd/lu_env/he/decisions/cy2010/he-rd-100408-007.pdf

found in Puget Sound are usually located south of the Tacoma Narrows where no netpens are located.[108]

The canary rockfish is a deepwater rockfish species which inhabits waters at depths between 160-820 feet.[109] These depths are deeper, overall, than the waters under the netpens.

Yelloweye rockfish occur in waters 80 to 1560 feet deep, most commonly between 300 feet to 590 feet, with juveniles.[110] Yelloweye rockfish are often found in high relief rocky habitats near steep slopes and are more common in the North Sound.[111] Based on their common distribution, the existing netpen operations are not located in areas where yelloweye rockfish typically would inhabit.

Primary stressors to rockfish populations include fishery removals, derelict fishing gear, hypoxia and food web interactions.[112] Bioaccumulative chemical contamination is also a moderate risk to rockfish species, in which netpens are not a source. Due to the deficiency of scientific evidence that the existing salmon netpen facilities in Puget Sound harm rockfish species through escape, disease transfer, and other indirect effects; the overall lack of an overlap between the existing netpen facilities and primary rockfish habitat; and the small quantity of netpen operations in Puget Sound, EPA has concluded the existing netpen facilities carry an insignificant risk of negatively affecting rockfish.

Therefore, EPA has concluded that its approval of WAC 173-204-412 **may affect, but is not likely to adversely affect** the following listed species:

Sebastes paucispinis	Bocaccio
Sebastes pinniger	Canary Rockfish
Sebastes ruberrimus	Yelloweye Rockfish

Critical habitat has not yet been designated for these three species of rockfish. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. Any effects to listed species may also have an effect to critical habitat whereas they affect substrate, food and habitat. EPA believes that since its action are NLAA

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[107] NOAA Fisheries. Office of Protected Resources. Bocaccio *(Sebastes paucispinis).* http://www.nmfs.noaa.gov/pr/species/fish/bocaccio.htm

[108] NOAA Fisheries. Office of Protected Resources. Bocaccio *(Sebastes paucispinis).* http://www.nmfs.noaa.gov/pr/species/fish/bocaccio.htm

[109] NOAA Fisheries. Office of Protected Resources. Canary Rockfish *(Sebastes pinniger).* http://www.nmfs.noaa.gov/pr/species/fish/canaryrockfish.htm

[110] NOAA Fisheries. Office of Protected Resources. Yelloweye Rockfish *(Sebastes ruberrimus).* http://www.nmfs.noaa.gov/pr/species/fish/yelloweyerockfish.htm

[111] Palsson, Wayne A. et al. "The Biology and Assessment of Rockfishes in Puget Sound." Washington Department of Fish and Wildlife. September 2009. http://wdfw.wa.gov/publications/00926/wdfw00926.pdf

[112] Palsson, Wayne A. et al. "The Biology and Assessment of Rockfishes in Puget Sound." Washington Department of Fish and Wildlife. September 2009. http://wdfw.wa.gov/publications/00926/wdfw00926.pdf

listed rockfish species based on minimal overlap of common habitat, any effects on designated critical habitat in the future would be even more inconsequential.

6.C. ANALYSIS OF EFFECTS ON MARINE MAMMALS

Based on the above rationale, EPA has concluded its approval of WAC 173-204-412 would not adversely affect individual listed marine mammals since the effects are considered insignificant. Insignificant effects relate to the size of the impact and do not reach a scale where take occurs.[113] The main route of exposure to marine mammals from netpens would be negative effects to the prey base. This BE estimates that affects to prey will be insignificant or discountable. This includes the analysis that determines:

- NOAA technical memorandums determine beneficial affects and low potential for negative affects.
- The designated uses of Puget Sound are protected.
- Netpen facilities have an insignificant impact on aquatic life in Puget Sound.
- The existing regulatory framework for netpens provides protection to surrounding habitat and other species.
- The effects on the benthic community are accounted for and monitored.
- The closure procedures of netpen facilities ensure the aquatic environment is restored to baseline levels.
- The indirect effects of netpen facilities carry a low risk.

The Steller sea lion occurs in Washington but there are no breeding rookeries in the state. The most important habitat requirements for the Steller sea lion are Alaskan beaches used as rookeries for breeding and pupping. Steller sea lions have been observed on netpen equipment storage barges in Rich Passage. Deterrence methods have been proposed by the netpen facilities to address this issue so that Steller sea lions are not adversely affected. These methods include predator barrier nets and passive barrier fences where the sea lions have been observed hauled out. In addition, several of the storage floats will be removed by the facility to limit haulout availability. Vessels servicing the facility may cause short-term and localized disturbances, but they are not expected to have any lasting effects. There is adequate space to accommodate passage around the existing netpen facilities so any effects on passage are expected to be insignificant.[114] The Steller sea lion typically feeds on fish and large invertebrates such as squid and octopus, so effects to benthic environment exposure are considered minimal to the Steller sea lion prey base. EPA expects its approval of the marine finfish rearing facility provision to have an insignificant effect on Steller sea lion rookery habitat or prey base.

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[113] U.S Fish and Wildlife Service and National Marine Fisheries. "Consultation Handbook: *Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act*." 1998.

[114] March 16, 2010. Letter from Barry A. Thom, Acting Regional Administrator, Northwest Region, NMFS to Michelle Walker, Chief, Seattle Regulatory Branch, U.S. Army Corps of Engineers Re: ESA and EFH Consultation for American Gold Seafoods Net-Pen Array Relocation.

The Humpback Whale is not often found in Washington, especially within Puget Sound. There were 30 sightings of humpback whales in Puget Sound in 2004.[115] Humpback Whales are more common off the pacific coast of Washington, which is a primary migratory corridor. The marine finfish rearing facility does not impact the major migratory corridor of Humpback Whales since there are no facilities on Washington's pacific coast. In addition, humpback whales do not rely heavily on benthic feeding, so effects to the benthic environment are considered minimal. Therefore, EPA expects its approval of the marine finfish rearing facility provision to have an insignificant effect on the Humpback Whale.

Southern resident Killer Whales are regular inhabitants of Puget Sound. Marine netpens are insignificant in their overall size and are therefore not expected to impact Killer Whale habitat. Vessels servicing the facility may cause short-term and localized disturbances but are not expected to have any lasting effects. There is adequate space to accommodate passage around the existing netpen facilities so any effects on passage are expected to be insignificant.[116] Since a NLAA determination was supported for listed salmonids in Puget Sound, Killer Whales also are not likely to be adversely affected since salmonids are a primary prey base. As a result, EPA expects its approval of the marine finfish rearing facility provision to have an insignificant effect on the Killer Whale.

Other than limited and non-lethal predator control permitted by National Marine Fisheries Service (NMFS), the technical memorandums do not state any concerns of adverse effects to marine mammals in Puget Sound in relation to Atlantic salmon rearing facilities.[117] Furthermore, Washington's PCHB specifically noted in its 1997 ruling that the operation of netpen facilities in Puget Sound does not have a negative impact on marine mammals.[118] EPA has concluded that its approval of WAC 173-204-412 **may affect, but is not likely to adversely affect** the following listed species:

Eumetpoias jubatus	Steller Sea Lion (Pacific Coast, eastern population)
Megaptera novaeangliae	Humpback Whale (Pacific Coast)
Orinus orca	Killer Whale (Southern Resident, DPS)

6.D. EFFECTS OF THE ACTION ON CRITICAL HABITAT

The listed species with designated critical habitat analyzed in the Biological Evaluation are Chinook salmon (Puget Sound ESU), Chum salmon (Hood Canal summer-run ESU), and Killer Whale (Southern Resident, DPS).

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[115] Falcone, Erin et. al. "Humpback Whales in the Puget Sound/Georgia Strait Region." 2005 Puget Sound/Georgia Basin Research Conference. <http://www.engr.washington.edu/epp/psgb/2005psgb/2005proceedings/papers/A2_FALCO.pdf>

[116] March 16, 2010. Letter from Barry A. Thom, Acting Regional Administrator, Northwest Region, NMFS to Michelle Walker, Chief, Seattle Regulatory Branch, U.S. Army Corps of Engineers Re: ESA and EFH Consultation for American Gold Seafoods Net-Pen Array Relocation.

[117] Nash, C.E. NOAA Fisheries Technical Memorandum. NFS-NWFSC-49. 2001. Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.

[118] Washington State Department of Ecology. NPDES Permit Factsheets for American Gold Seafoods, Inc. 2007.

NOAA and USFWS designate critical habitat based on physical and biological features that are essential to listed species. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. In the Analysis of Effects section above, the effects to the listed species from EPA's approval of the marine finfish rearing facility provision are examined. Any effects to listed species may also have an effect to critical habitat whereas they affect substrate, food and habitat. This BE determined that EPA's approval of these standards are NLAA listed species, therefore, any affects on critical habitat would be even more inconsequential. As a result, the effects for critical habitat are NLAA for the species analyzed in this Biological Evaluation that have been assigned a critical habitat.

7. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private action on endangered or threatened species or critical habitat that are reasonably certain to occur in the action area considered in this biological evaluation. Further federal actions or actions on federal lands that are not related to the proposed action are not considered in this section.

Future anticipated nonfederal actions that may occur in or near Puget Sound include agriculture, urban development, commercial fishing, recreation, transportation, nonpoint source pollution and other human interactions. In addition, sewage treatment plants and marinas have effects on the Puget Sound aquatic environment similar to netpen facilities, although netpen impact is much less than these sources.[119] These nonfederal actions are likely to continue having adverse effects on the endangered and threatened species, and their habitat. There are also nonfederal actions likely to occur in or near Puget Sound that are likely to have beneficial effects on the endangered and threatened species. These include best management practices associated with a variety of human activities, such as urban development and recreational activities.

Interdependent actions are defined as actions with no independent use apart from the proposed action. Interrelated actions include those that are part of a larger action and depend on the larger action for justification. There are no interdependent or interrelated actions expected as a result of approval of these water quality provisions.

[119] Waknitz, F.W., et al. NOAA Fisheries Technical Memorandum. NFMFS-NWFSC-53. 2002.

8. SUMMARY OF FINDINGS

Table 8-1 summarizes EPA's determination of NLAA for ESA-listed species, under NOAA jurisdiction, analyzed for EPA's approval of Washington's marine finfish rearing facility provision, WAC 173-204-412.

Table 8-1 NLAA Summary of Findings.

Species	**ESU/DPS/Population**	**Effects Determination for EPA's Approval of WAC 173-204-412**
Chinook Salmon (*Oncorhynchus tshawytscha*)	Puget Sound ESU	NLAA
Chum Salmon (*Oncorhynchus keta*)	Hood Canal summer-run ESU	NLAA
Steelhead (*Oncorhynchus mykiss*)	Puget Sound, DPS	NLAA
Steller Sea Lion (*Eumetpoias jubatus*)	Pacific Coast, eastern pop.	NLAA
Humpback Whale (*Megaptera novaeangliae*)	Pacific Coast	NLAA
Killer Whale (*Orinus orca*)	Southern Resident, DPS	NLAA
Bocaccio (*Sebastes paucispinis*)	N/A	NLAA
Canary Rockfish (*Sebastes pinniger*)	N/A	NLAA
Yelloweye Rockfish (*Sebastes ruberrimus*)	N/A	NLAA

NLAA – Not likely to adversely affect

Table 8-2 summarizes EPA's determination of NE for ESA-listed species, under NOAA jurisdiction, analyzed for EPA's approval of Washington's marine finfish rearing facility provision, WAC 173-204-412.

Table 8-2 NE Summary of Findings.

Species	**ESU/DPS/Population**	**Effects Determination for EPA's Approval of WAC 173-204-412**
Chinook Salmon *(Oncorhynchus tshawytscha)*	Snake River Fall Run Lower Columbia River Upper Columbia River Spring Run Snake River Spring/Summer Run	NE
Chum Salmon *(Oncorhynchus keta)*	Columbia River	NE
Coho Salmon *(Oncorhynchus kisutch)*	Lower Columbia River	NE
Sockeye Salmon *(Oncorhynchus nerka)*	Ozette Lake	NE

Species	ESU/DPS/Population	Effects Determination for EPA's Approval of WAC 173-204-412
Steelhead *(Oncorhynchus mykiss)*	Snake River Basin Lower Columbia River Upper Columbia River Basin Middle Columbia River	NE
Southern Sea Otter (*Enhydra lutris neries*)		NE
Steller Sea Lion (*Eumetpoias jubatus*)	Western population	NE
Green Sea Turtle (*Chelonia mydas*)		NE
Leatherback Sea Turtle (*Dermochelys coriacea*)		NE

NE – No effect

9. SEDIMENT TESTING METHODOLOGY PROVISIONS

Several revisions to WAC 173-204, listed below, relate to sediment testing methodology, were described in EPA's August 6, 2008 supplement to the 2008 BE. EPA has reevaluated its conclusions in the August 6, 2008 supplement based upon any new information and is reaffirming these conclusions in this BE as these provisions relate only to sediment testing methodology. The changes to these provisions are provided in *Appendix 11.B.*

EPA has determined that its proposed approval action of the following changes to Washington's SMS may affect, but is not likely to adversely affect any federally listed endangered or threatened species or their designated critical habitat:

- WAC 173-204-315(1)(b)(ii): Juvenile polychaete chronic effects tests;
- WAC 173-204-315(2)(b): Larval performance standards for control and reference sediment biological test results;
- WAC 173-204-315(2)(d): Juvenile polychaete performance standards for control and reference sediment biological test results;
- WAC 173-204-320(3)(d): Juvenile polychaete biological effects criteria;
- WAC 173-204-430(3)(c)(iv): Juvenile polychaete Puget Sound marine sediment impact zone maximum biological effects criteria; and
- WAC 173-204-520(3)(d)(iv): Juvenile polychaete Puget Sound marine sediment cleanup screening levels and minimum cleanup level biological criteria.

Below is a summary of the revised provisions. Since four of the provisions have repetitive changes, these have been grouped together. The full text of these revised provisions is included in strikethrough language in *Appendix 11.B.*

WAC 173-204-315(1)(b)(ii), WAC 173-204-320(3)(d), WAC 173-204-430(3)(c)(iv), WAC 173-204-520(3)(d)(iv)

These four provisions have been changed to replace biomass with mean individual growth rate. The purpose of this revised endpoint is to improve sediment testing of juvenile polychaete in order to determine and monitor sediment quality. This is accomplished by comparing biological responses to exposure to test sediment to biological response to exposure to a reference sediment. After Ecology's adoption of the SMS in 1991, the Puget Sound Dredged Disposal Analysis (PSDDA) and Puget Sound Estuary Program (PSEP) implemented this revised endpoint determination and bioassay test procedure.[120] This revision is an updated metric to measure change in juvenile polychaete size to determine if sediment quality has inhibited growth.

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[120] Betts, Brett. Washington State Department of Ecology Triennial Review of Sediment Management Standards (SMS) Rule. Chapter 173-204 WAC. "Review of New Scientific Information and Proposed Modification to the SMS Rule – Juvenile Polychaete Bioassay." May 1995.

WAC 173-204-315(2)(b)
This provision establishes acceptable survivorship for larval bivalve seawater control and reference sediment biological samples. As such, this revision modifies the seawater control sample for larval normal survivorship from 50% to 70%. The change in larval survivorship is more stringent and consistent with protocols and recommendations by PSDDA in 1994 and PSEP in 1986, which are based on best available science.[121]

WAC 173-204-315 (2)(d)
The provision specifies a mean individual growth rate of $\geq$ 0.72 mg/ind/day for the juvenile polychaete control sediment, replacing biomass as the measurement endpoint. This revision ensures the growth of juvenile polychaete in control samples have not been inhibited, and thus serve as a more accurate basis for comparison to tested samples. The mean individual growth rate of $\geq$ 0.72 mg/ind/day is consistent with best available scientific recommendations by PSDDA in 1995 and the U.S. Army Corps of Engineers Waterways Experiment Station in 1993.[122]

NLAA Analysis
The revised provisions update several of the metrics used for juvenile polychaete growth and larval bivalve survivorship for control and reference sediment biological test results based on best available science. The provisions adjust the sediment test methods to improve the accuracy and precision of test measurements and to help ensure that control samples indicate valid test results. As such, they represent minor revisions to the established criteria that serve to improve the reliability of test results. Because the test results serve as the protective criteria, these are new or revised water quality standards as the binding requirements for biological test performance collectively define the level of protection and expectation for ambient conditions. All activities subject to the SMS regulation are also subject to these revised provisions, including marine finfish rearing facilities.

Although these revisions may improve the ability to discern whether the condition of the benthic community is different from reference conditions, these changes are not reasonably expected to have any adverse affect on listed or threatened fish species, bird species, marine mammals or their critical habitat. The criteria at issue serve to protect the benthic (i.e., bottom dwelling) community from the adverse effects of pollutants. Listed or threatened species in the marine waters of Washington are members of the pelagic (i.e., open water) community. Interactions between the communities can lead to indirect effects of two types: 1) indirect effects of pollutants accumulating in benthic tissue and transferred to pelagic species via the food chain, and 2) indirect effects of loss of benthic community food sources through mortality. In either instance, the minor revisions to the criteria may affect, but are not likely to adversely affect listed species. For pollutant

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[121] Sparks-McConkey, Pamela. Washington State Department of Ecology Triennial Review of Sediment Management Standards (SMS) Rule. Chapter 173-204 WAC. "Review of New Scientific Information and Proposed Modifications to the SMS Rule – Larval Bioassay." May 1995.
[122] Betts, Brett. Washington State Department of Ecology Triennial Review of Sediment Management Standards (SMS) Rule. Chapter 173-204 WAC. "Review of New Scientific Information and Proposed Modification to the SMS Rule – Juvenile Polychaete Bioassay." May 1995.

exposure via the food chain, the specific tests do not measure bioaccumulation or address that route of exposure in any way; the effects tested are solely direct lethal and sub-lethal effects to representative members of the benthic community. For loss of food source, the overall allocation of sediment impact zones in Puget Sound that could result from implementation of the SMS is an exceedingly small fraction of the feeding area for species that any listed or threatened species might, in part, rely on, and is thus of no adverse consequence in terms of effect. Furthermore, the small changes (i.e., reductions) of sediment impact zone size that could result from application of these revisions represent an even smaller fractional size than originally considered insignificant as stated above. The revisions are solely directed at protecting benthic species habitat for their own sake, not for their ability to serve as a safe and meaningful food source to pelagic fish species, bird species or marine mammals that have a large foraging area.

Because these revisions are solely focused on the quality of the control and reference sediment samples for juvenile polychaete growth and larval bivalve survivorship that serve to improve the reliability of test results for benthic community protection, EPA concludes this action **may affect, but is not likely to adversely affect** endangered or threatened species or designated critical habitat for the following species:

Oncorhynchus tshawytscha	Chinook Salmon (Puget Sound ESU, Snake River Fall Run, Lower Columbia River, Upper Columbia River Spring Run, Snake River Spring/Summer Run)
Oncorhynchus keta	Chum Salmon (Hood Canal summer-run ESU, Columbia River)
Oncorhynchus nerka	Sockeye Salmon (Ozette Lake)
Oncorhynchus mykiss	Steelhead (Puget Sound DPS, Snake River Basin, Lower Columbia River, Upper Columbia River Basin)
Eumetpoias jubatus	Steller Sea Lion (Pacific Coast, eastern population)
Megaptera novaeangliae	Humpback Whale (Pacific Coast)
Orinus orca	Killer Whale (Southern Resident, DPS)
Sebastes paucispinis	Bocaccio
Sebastes pinniger	Canary Rockfish
Sebastes ruberrimus	Yelloweye Rockfish

EPA contemplated a no effect determination since any possible effects would be extremely minor, but EPA was unclear of the threshold between a no effect and a not likely to adversely affect determination. Therefore, EPA chose to be cautious and make a not likely to adversely affect determination for these species.

EPA has determined its approval of these revised provisions will have **no effect** (NE) on the remaining listed species in Washington[123] since they either do not inhabit the marine aquatic system of Washington and therefore would not be exposed to any possible effects from these action or the only possibility for exposure to the effects of these standard changes would be alterations to the prey base of the benthic community, which is not the case for these species.

Effects of the Action on Critical Habitat

The listed species with designated critical habitat analyzed in the Biological Evaluation are Chinook salmon (Puget Sound ESU), Chum salmon (Hood Canal summer-run ESU), and Killer Whale (Southern Resident, DPS).

NOAA designates critical habitat based on physical and biological features that are essential to listed species. Essential features of designated critical habitat include substrate, water quality, water quantity, water temperature, food, riparian vegetation, access, water velocity, space and safe passage. In the Analysis of Effects section above, the effects to the listed species from EPA's approval of the marine finfish rearing facility provision are examined. Any effects to listed species may also have an effect to critical habitat whereas they affect substrate, food and habitat. This BE determined that EPA's approval of these standards are NLAA listed species, therefore, any affects on critical habitat would be even more inconsequential. As a result, the effects for critical habitat are NLAA for the species analyzed in this Biological Evaluation that have been assigned a critical habitat.

[123] U.S Fish and Wildlife Service. USFWS Threatened and Endangered Species System (TESS). Washington State. Accessed online August 17, 2010. <http://ecos.fws.gov/tess_public/StateListingAndOccurrence.do?state=WA>

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11. APPENDICES

11.A. MARINE FINFISH REARING FACILITY PROVISION

WAC 173-204-412 Marine finfish rearing facilities. [124]

(1) Purpose. This section sets forth the applicability of this chapter to marine finfish rearing facilities only. This section also identifies marine finfish rearing facility siting, operation, closure and monitoring requirements to meet the intent of this chapter, as applicable.

(2) Applicability. Marine finfish rearing facilities and their associated discharges are not subject to the authority and purpose standards of WAC 173-204-100 (3) and (7), and the marine sediment quality standards of WAC 173-204-320 and the sediment impact zone maximum criteria of WAC 173-204-420, within and including the distance of one hundred feet from the outer edge of the marine finfish rearing facility structure. Marine finfish rearing facilities are not subject to the sediment impact zone standards of WAC 173-204-415.

(3) Sediment monitoring. Sediment quality compliance and monitoring requirements for marine finfish rearing facilities shall be addressed through National Pollutant Discharge Elimination System or other permits issued by the department for facility operation. Marine finfish rearing facilities shall meet the following sediment quality monitoring requirements:

(a) Any person with a new facility shall identify a baseline sediment quality prior to facility operation for benthic infaunal abundance, total organic carbon and grain size in the location of the proposed operation and downcurrent areas that may be potentially impacted by the facility discharge;

(b) Any person with an existing operating facility shall monitor sediment quality for total organic carbon levels and identify the location of any sediments in the area of the facility statistically different (t test, $p \leq 0.05$) from the total organic carbon levels identified as facility baseline levels or statistically different from the applicable total organic carbon levels as identified in Table 1:

TABLE 1 - Puget Sound Reference Total Organic Carbon Values

Silt-Clay Particles (percent Dry Weight)	Total Organic Carbon (percent Dry Weight)
0-20	0.5
20-50	1.7
50-80	3.2
80-100	2.6

(c) The locations and frequency of monitoring for total organic carbon, benthic infaunal abundance and other parameters shall be determined by the department and identified in the applicable National Pollutant Discharge Elimination System permit;

(d) Antibacterials. Reserved: The department shall determine on a case-by-case basis the methods, procedure, locations, and frequency for monitoring antibacterials associated with the

[124] http://apps.leg.wa.gov/WAC/default.aspx?cite=173-204-412

discharge from a marine finfish rearing facility;

(e) Closure. All permitted marine finfish rearing facilities shall monitor sediments impacted during facility operation to document recovery of sediment quality to background levels. The department shall determine on a case-by-case basis the methods, procedure, locations, and frequency for monitoring sediments after facility closure.

(4) Sediment impact zones. Marine finfish rearing facilities and their associated discharges that are permitted under a National Pollutant Discharge Elimination System permit are hereby provided a sediment impact zone by rule for any sediment quality impacts and biological effects within and including the distance of one hundred feet from the outer edge of the marine finfish rearing facility structure.

(a) The department may authorize an individual marine finfish rearing facility sediment impact zone for any sediments beyond a distance of one hundred feet from the facility perimeter via National Pollutant Discharge Elimination System permits or administrative actions. The authorized sediment impact zone shall meet the benthic infaunal abundance requirements of the sediment impact zone maximum criteria, WAC 173-204-420 (3)(c)(iii). Marine finfish rearing facilities that exceed the sediment quality conditions of subsection (3)(b) of this section beyond a distance of one hundred feet from the facility perimeter shall:

(i) Begin an enhanced sediment quality monitoring program to include benthic infaunal abundance consistent with the requirements of the National Pollutant Discharge Elimination System permit. The sediment quality monitoring program shall include a benthic infaunal abundance reference sediment sample as required in subsection (3)(a) of this section or a benthic infaunal abundance reference sediment sample in compliance with WAC 173-204-200(21); and

(ii) Be consistent with the sediment source control general considerations of WAC 173-204-400 and the sediment quality goal and sediment impact zone applicability requirements of WAC 173-204-410, apply for a sediment impact zone as determined necessary by the department.

(b) Administrative orders or permits establishing sediment impact zones for marine finfish rearing facilities shall describe establishment, maintenance, and closure requirements as determined necessary by the department.

11.B. SEDIMENT TESTING METHODOLOGY PROVISIONS

WAC 173-204-315(1)(b)(ii) Juvenile polychaete: *Twenty-day ((~~biomass~~)) growth rate of the juvenile polychaete Neanthes arenaceodentata; or*

WAC 173-204-315(2)(b) Larval: *The seawater control sample shall have less than ((~~fifty~~)) thirty percent combined abnormality and mortality (i.e., a ((~~fifty~~)) seventy percent normal survivorship at time-final).*

WAC 173-204-315 (2)(d) Juvenile polychaete: *The control sediment shall have less than ten percent mortality and mean individual growth of ≥ 0.72 mg/ind/day per dry weight basis. The reference sediment shall have a mean ((~~biomass~~)) individual growth rate which is at least eighty percent of the mean ((~~biomass~~)) individual growth rate found in the control sediment. Control sediments exhibiting growth below 0.72 mg/ind/day may be approved by the department on a case-by-case basis.*

WAC 173-204-320 (3)(d) Juvenile polychaete: *The test sediment has a mean ((~~biomass~~)) individual growth rate of less than seventy percent of the reference sediment mean ((~~biomass~~)) individual growth rate and the test sediment ((~~biomass~~)) mean individual growth rate is statistically different (t test, p ≤0.05) from the reference sediment ((~~biomass~~)) mean individual growth rate.*

WAC 173-204-420 (3)(c)(iv) Juvenile polychaete: *The test sediment has a mean ((~~biomass~~)) individual growth rate of less than seventy percent of the reference sediment mean ((~~biomass~~)) individual growth rate and the test sediment ((~~biomass~~)) mean individual growth rate is statistically different (t test, p ≤0.05) from the reference sediment ((~~biomass~~)) mean individual growth rate.*

WAC 173-204-520 (3)(d)(iv) Juvenile polychaete: *The test sediment has a mean ((~~biomass~~)) individual growth rate of less than fifty percent of the reference sediment mean ((~~biomass~~)) individual growth rate and the test sediment ((~~biomass~~)) mean individual growth rate is statistically different (t test, p ≤0.05) from the reference sediment ((~~biomass~~)) mean individual growth rate.*

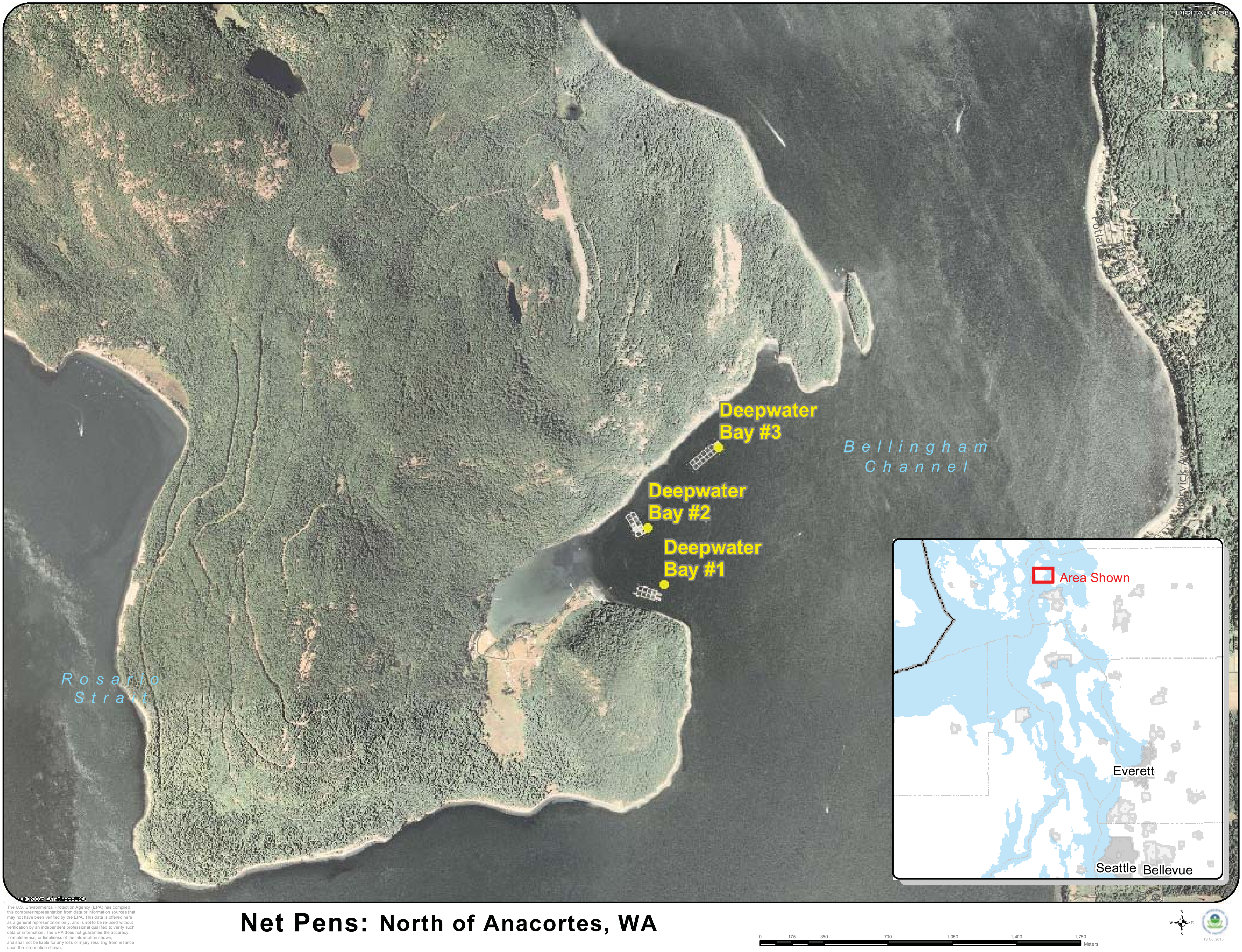
11.C. MAPS OF NETPEN FACILITIES

Table 11-1 Latitude and Longitude of Netpen Facilities.

Facility	Latitude	Longitude
Clam Bay	47° 34’ 15" N	122° 32’ 25" W
Fort Ward*	47° 34’ 30" N	122° 31’ 30" W
Orchard Rocks	47° 34’ 30" N	122° 31’ 50" W
Deepwater Bay #1	48° 33’ 15.6" N	122° 41’ 01" W
Deepwater Bay #2	48° 33’ 25.6" N	122° 41’ 05" W
Deepwater Bay #3	48° 33’ 39.8" N	122° 40’ 46" W
Hope Island	48° 24’ 28" N	122° 33’ 32" W
Port Angeles - Ediz Hook	48° 08’ 23" N	123° 25’ 07" W

* On May 27, 2010, the Kitsap County Hearing approved a request for a Shoreline Substantial Development Permit and Shoreline Conditional Use Permit to relocate the Fort Ward netpen structure to a new location adjacent to the existing Clam Bay netpen facility, 800 feet off the west shore of Rich Passage. http://www.kitsapgov.com/dcd/lu_env/he/decisions/cy2010/he-rd-100408-007.pdf.

Net Pens: South of Bainbridge Island



Net Pens: North of Anacortes, WA

Net Pens: Hope Island, WA

0 100 200 400 600 800 1,000 Meters

Net Pens: Port Angeles

0 462.5 925 1,850 2,775 3,700 4,625 Meters