United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

JUL - 8 2013

In Reply Refer To:
01EWFW00-2013-F-0360

R.F. Krochalis
Regional Administrator
Federal Transit Administration
Jackson Federal Building
915 Second Avenue, Suite 3142
Seattle, Washington 98174

Mr. Krochalis:

This letter transmits the U. S. Fish and Wildlife Service's Biological Opinion (Opinion) based on our review of the proposed Mukilteo Multimodal Project located in Snohomish County, Washington, and Possession Sound, and its effects on bull trout (*Salvelinus confluentus*) and designated critical habitat for bull trout in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your October 24, 2012 request for formal consultation was received on October 30, 2012.

In addition, the Opinion includes concurrence with your "may affect, not likely to adversely affect" determination for marbled murrelet (*Brachyramphus marmoratus*). The rationale for this concurrence is provided in the concurrence section of the Opinion.

This Opinion is based on information provided in the October 24, 2012 *Mukilteo Multimodal Project Reference Biological Assessment Project Form*, the April 2012 *Biological Assessment Reference for Washington State Ferries Capital, Repair, and Maintenance Projects*, the (April 2012) draft *Hydrodynamic and Sediment Transport Modeling Study – Mukilteo Ferry Terminal*, the (June 2012) draft *Sediment Sampling Data Report* (August 2012), the (November 2012) final *Sediment Sampling Data Report*, the December 2003 *Water Resources Technical Report: Mukilteo Multimodal Project*, the December 2003 *Hazardous Materials Assessment: Former Defense Fuel Support Point Mukilteo Property*, the (August 2012) draft Environmental Assessment for Transfer of the Mukilteo Tank Farm, the (October 2012) Final Environmental Assessment and Finding of No Significant Impact/Finding of No Practicable Alternative for Transfer of the Mukilteo Tank Farm, and other sources of information. A complete record of this consultation is on file at the U.S. Fish and Wildlife Service office in Lacey, Washington.

If you have any questions regarding the Opinion or our joint responsibilities under the Endangered Species Act, please contact Julie Hampden at (206-755-8397 or Emily Teachout at (360) 753-9583, of this office.

Sincerely,

for Ken S. Berg, Manager
Washington Fish and Wildlife Office

Enclosure(s)

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
01EWFW00-2013-F-0360

Mukilteo Multimodal Project

Snohomish County, Washington

Agency:

Federal Transit Administration
Seattle, Washington

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

Ken S. Berg, Manager
Washington Fish and Wildlife Office

July 8, 2013
Date

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LIST OF ACRONYMS AND ABBREVIATIONS

Act	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)
BA	Biological Assessment
BMP	Best Management Practices
COC	contaminants of concern
cy	cubic yards
DCu	dissolved copper
DMMP	Dredge Material Management Program
DZn	dissolved zinc
Ecology	Washington State Department of Ecology
FMO	foraging, migration, and overwintering
Form	Mukilteo Multimodal Project Reference Biological Assessment Project Form
FTA	Federal Transit Authority
MHHW	mean higher high-water
MLLW	mean lower low-water
NMFS	National Marine Fisheries Service
NTU	Nephelometric Turbidity Units
Opinion	Biological Opinion
PAH	polycyclic aromatic hydrocarbons
PGIS	pollution-generating impervious surface
Project	Mukilteo Multimodal Project
RPM	Reasonable and Prudent Measures
SEL	sound exposure level
Services	U.S. Fish and Wildlife Service, and National Marines Fisheries Service
SPL	sound pressure levels
SQS	Sediment Quality Standards
SR	State Route
TCu	total copper
TL	transmission loss
TSS	total suspended solids
TZn	total zinc
USAF	U.S. Air Force
USFWS	U.S. Fish and Wildlife Service
WSF	Washington State Ferries

INTRODUCTION

This document transmits the U. S. Fish and Wildlife Service's (USFWS) Biological Opinion (Opinion) based on our review of the proposed Mukilteo Multimodal Project (Project) located in Snohomish County, and Possession Sound, and its effects on bull trout and designated bull trout critical habitat in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). The Federal Transit Administration (FTA) requested formal consultation in a letter and accompanying Form, dated October 24, 2012, that was received by USFWS on October 30, 2012.

This Opinion is based on information provided in the October 24, 2012 *Mukilteo Multimodal Project Reference Biological Assessment Project Form* (*Form*), the April 2012 *Biological Assessment Reference for Washington State Ferries Capital, Repair, and Maintenance Projects* (BA), the (April 2012) draft *Hydrodynamic and Sediment Transport Modeling Study – Mukilteo Ferry Terminal*, the (June 2012) draft *Sediment Sampling Data Report* (August 2012), the (November 2012) final *Sediment Sampling Data Report*, the December 2003 *Water Resources Technical Report: Mukilteo Multimodal Project*, the December 2003 *Hazardous Materials Assessment: Former Defense Fuel Support Point Mukilteo Property*, the (August 2012) draft Environmental Assessment for Transfer of the Mukilteo Tank Farm, the (October 2012) Final Environmental Assessment and Finding of No Significant Impact/Finding of No Practicable Alternative for Transfer of the Mukilteo Tank Farm, and other sources of information. A complete record of this consultation is on file at the U.S. Fish and Wildlife Service office in Lacey, Washington.

CONSULTATION HISTORY

We based this Opinion on the following sources of information: a letter from the FTA to requesting formal consultation dated October 26, 2012, and received October 30, 2012, the Form completed by Washington State Ferries (WSF) dated October 24, 2012 and received October 30, 2012, and WSF responses to our requests for additional information (written correspondence received via email on November 28 and December 3, 4 and 10, 2012). A chronological summary of important consultation events follows:

- July 16 – WSF provided (via email) us with a preliminary draft of section 1 of the Form for review.

- July 18 – WSF provided us (via email) with a draft of the Mukilteo Hydrodynamics and Sediment Transport Modeling Study. On the same day, we provided (via email) WSF with comments on the preliminary sections of the Form.

- July 19 – We attended a meeting to discuss the Preferred Alternative (Elliot Point 2) Refinements, Sediment Transport Analysis, Sediment Sampling Results, and Effect of Sediment Transport on Aquatic Resources. On the same day, the National Marine Fisheries Service (NMFS) provided WSF and USFWS (via email) with a copy of Technical Guidelines for Environmental Dredging of Contaminated Sediments.

- August 8, 2012 – WSF provided USFWS (via email) a copy of the final Jimmycomelately Pile Removal Monitoring Project Report.

- August 14, 2012 – WSF provided us (via email) with a copy of the draft Mukilteo Sediment Sampling Report.

- August 30, 2012 – WSF provided us (via email) with a draft of the stormwater information for the Project for review.

- September 13, 2012 – WSF provides us (via email) with a preliminary draft of the Form for review.

- September 24, 2012 – We attended a meeting to discuss additional information needs for the BA.

- September 26, 2012 – We provided WSF (via email) with comments on the Form.

- October 18, 2012 – We attended a meeting to discuss: Temporary Effects on Water Quality from Pile Removal, Dredging, and Stone Column Installation; and Proposed Mitigation Measures for Aquatic Resource Impacts. Following the meeting, WSF provided meeting participants (via email) with a copy of the presentation from the meeting and also a Temporary Effects on Water Quality Technical Memorandum. NMFS provided meeting participants (via email) with a copy of a recent creosote pile study, *Creosote Release from Cut/Broken Piles, ASARCO Smelter Site*.

- October 29, 2012 – FTA and WSF provides us (via email and also mail) with a Form for review.

- November 7, 2012 – WSF provides us (via email) a copy of the final 2012 Sediment Sampling Data Report with an effect determination of "may affect, likely to adversely affect," Coastal-Puget Sound (CPS) bull trout (*Salvelinus confluentus*) and designated bull trout critical habitat, and "may affect, not likely to adversely affect," marbled murrelet (*Brachyramphus marmaratus*).

- November 13, 2012 – We provide WSF and FTA (via email) with comments on the Form.

- November 28, 2012 –WSF and Federal Transit Administration provides us (via email) with responses to comments on the Form and a revised marbled murrelet monitoring plan.

- December 3, 2012 – WSF provides clarification (via email) regarding the total number of concrete piles that will be driven.

- December 4, 2012 – WSF provides clarification (via email) regarding the duration of impact pile driving per pile.

- After receiving the December 4, 2012 email, we drafted a letter, dated December 19, 2012, to WSF and FTA indicating the complete consultation package was received and consultation was initiated.

- February 13, 2013 – WSF provides an updated project description and analysis of effects, reflecting a change in location for one of the project elements (public fishing pier).

- March 1, 2013 – We requested additional information (via email) regarding contaminant related Best Management Practices (BMPs) and containment of contaminants, the stability and/or permanence of the capping or proposed filling of holes left after piles are removed, capping of the dredge prism, stability of upland fill, the basis underlying the proposed sweeping schedule, use of light penetrating surfaces, ongoing maintenance of Filterra treatment systems, and whether climate change had been taken into consideration of project modeling. In addition, an updated bull trout critical habitat analysis was requested.

- March 15, 2013 – WSF provides an updated analysis for bull trout critical habitat Primary Constituent Elements (PCEs) that aligns with October 2010 critical habitat designation rule.

- March 20, 2013 – WSF provided updated pier demolition sequencing information via email.

- April 2, 2013 – WSF responds to questions in March 1 email described above.

- April 8, 2013 – We requested information regarding a Federal nexus of the Port of Everett Mount Baker Terminal Access project.

- April 18, 2013 – WSF provides Addendum to Final Environmental Impact Statement on Port of Everett Mount Baker Terminal Access project.

- April 26, 2013 – We provided a draft biological Opinion to the action agency for review.

- May 10, 2013 – WSF provides new Table 3 and suggested Terms and Conditions language.

- May 13, 2013 – WSF provides action agency comments to Opinion. We met with project team to discuss comments and revised terms and condition language.

- May 16, 2013 – WSF provides us with additional BMPs and monitoring specifications (turbidity and water quality monitoring) to address our concerns with resuspended contaminants and to ensure in-water Project impacts are limited to a 150-foot radius from piles.

CONCURRENCE

The Project will move the ferry terminal and public fishing pier east of their existing location in downtown Mukilteo to the former U.S. Department of Defense Fuel Supply Point Facility, known as the Tank Farm property, which includes a large pier extending into Possession Sound (Figure 1). The Project will remove the existing ferry terminal and fishing pier, as well as the Tank Farm Pier. In addition to constructing new terminal buildings, structures, and facilities, a new roadway will be also constructed to connect State Route (SR) 525 east to the Mukilteo Commuter Rail station, the ferry terminal and associated transit center, and Mt. Baker Crossing (Figure 2). The Project involves both marine and land components as described in detail below in the Opinion.

Project construction is scheduled to begin in 2015 and last for approximately two years. In-water work will occur between July 15 and February 15. Some work elements have more constrained in-water work windows, as negotiated with NMFS (i.e., dredging, pile removal). The Project will take place over three in-water work seasons.

The Project will remove a 138,080 square-foot (3.17 acres) over water pier (Tank Farm Pier) that contains approximately 3,900 creosote-treated piles. Piles will be removed with a vibratory hammer. Demolition will take approximately ten months over three in-water work windows. In addition, the existing Mukilteo ferry terminal will be removed once the new terminal is complete. The existing terminal comprises 8,120 square feet (ft^2) of overwater cover and contains 248 creosote-treated piles. The Port of Everett public fishing pier/seasonal day moorage will also be removed. The pier comprises 2,000 ft^2 of overwater cover and contains forty-two 12-inch diameter creosote-treated timber piles. Demolition of this structure will take approximately two weeks and will occur from land and from a barge containing the necessary equipment.

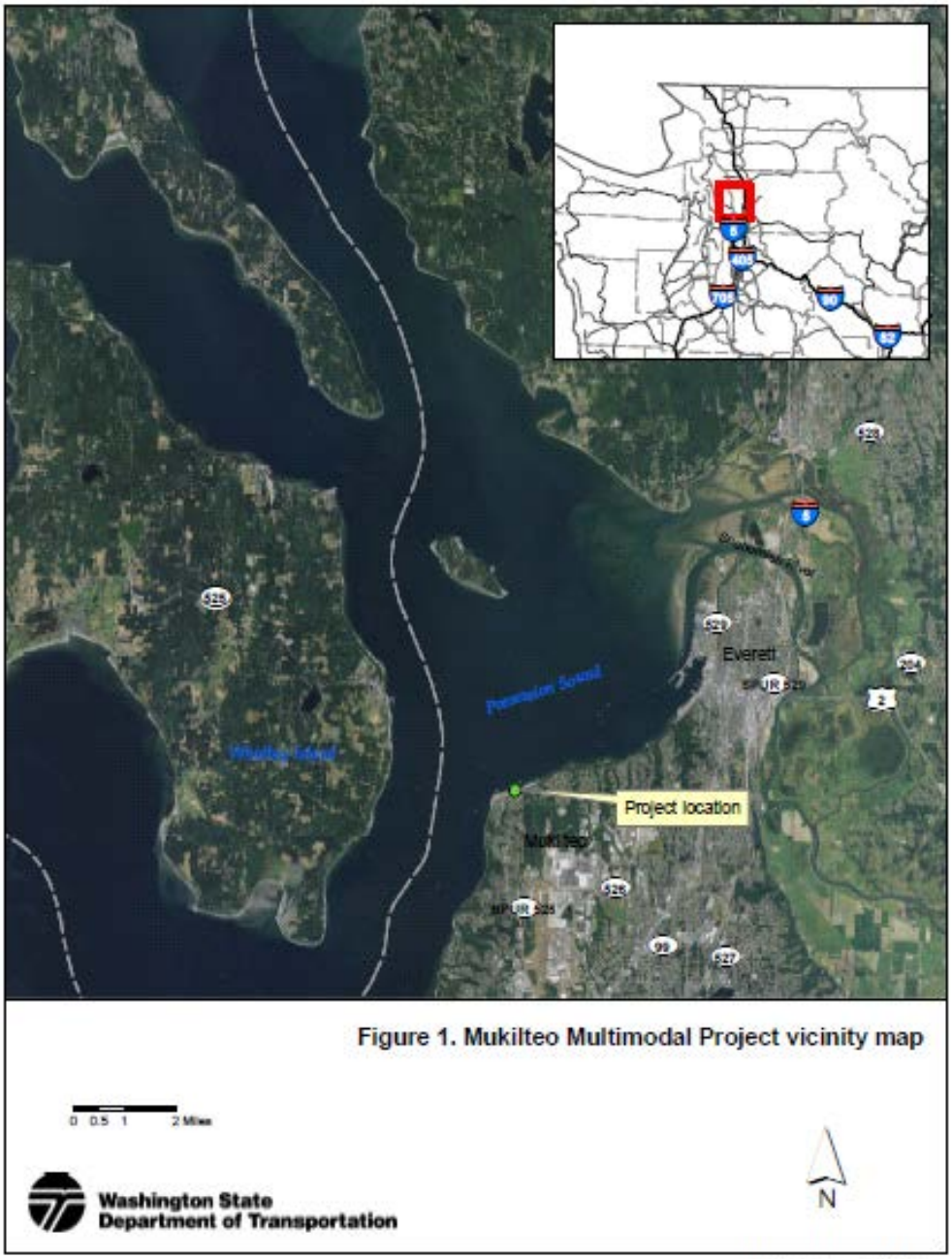

Figure 1. Mukilteo multimodal project location.

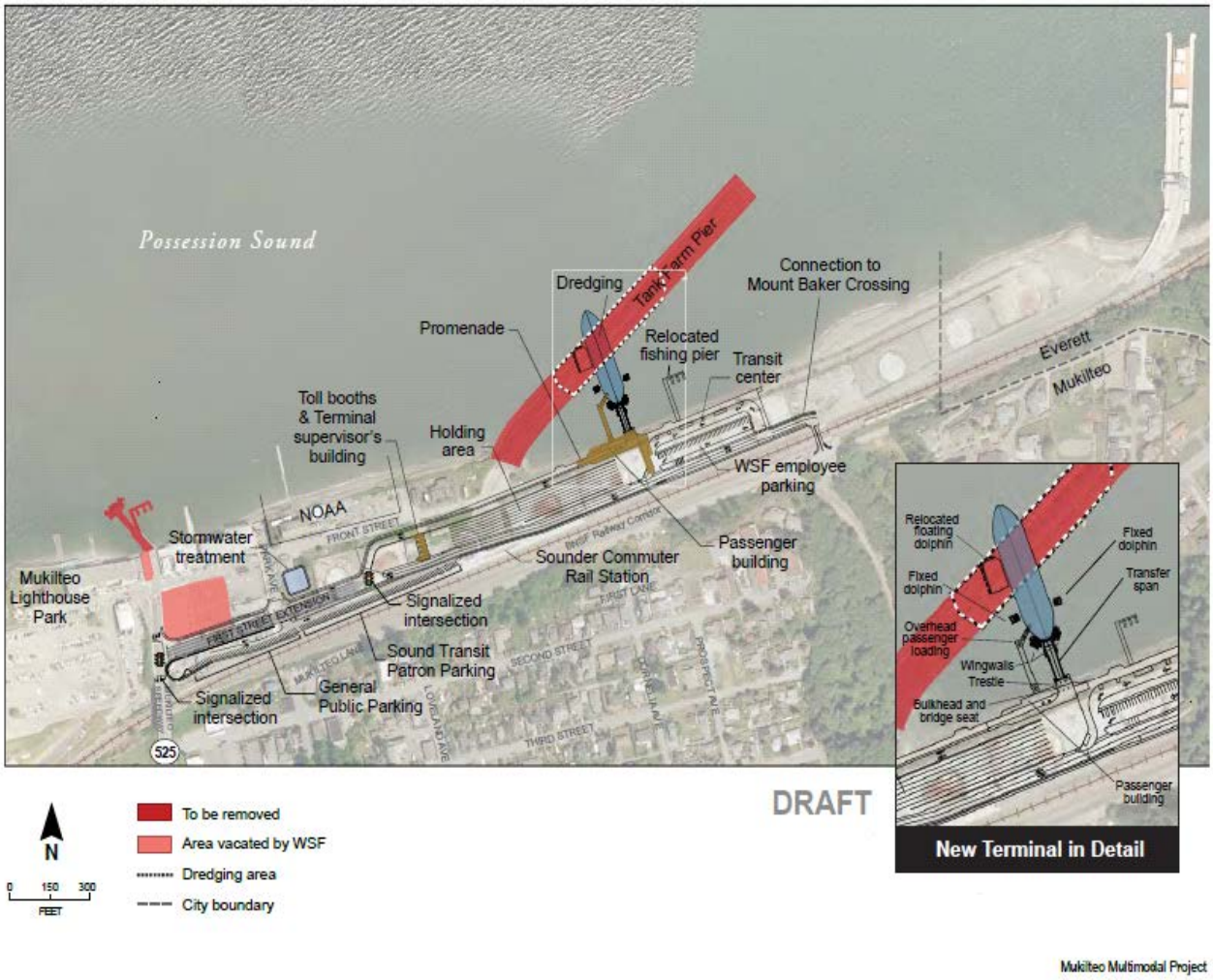

Figure 2. Project Elements

The Project will dredge approximately 23,500 cubic yards (cy) in an area 500 feet (ft) long x 100 ft wide to a depth of up to -30 mean lower low-water (MLLW) to provide a navigation channel through the sediment mound underneath the Tank Farm Pier. Dredging will last less than one month, and is currently scheduled for December 2015 to January 2016, when listed salmonids are least likely to be in the action area; however, the work could occur at any time during the in-water work window specified by NMFS for the dredging activities (November 1 to February 15). Spoils will generally be disposed of offshore in compliance with Dredge Material Management Program (DMMP) standards. Any dredged material that exceeds DMMP criteria will be removed and disposed of at existing upland facilities permitted to accept contaminated waste. Transport of contaminated material will use existing haul routes, such as state highways.

Approximately 200 stone columns, 3-ft in diameter, extending 60 ft below ground surface, will be installed in a grid pattern (with row spacing ranging from five to 10 ft) underneath the trestle, transfer span, and overhead loading structure over an area of approximately 25,000 ft^2. To construct the columns, approximately 3,142 cy of clean material (such as crushed gravel) will be inserted into the soil over a period of four weeks.

A new concrete trestle measuring 1,600 ft^2 will be supported by fourteen 24-inch diameter octagonal concrete piles that will be installed using an impact hammer. It will take as long as two hours to position and drive each pile over the course of five days. Estimated time for impact hammering is 15 minutes per pile.

A new transfer span measuring approximately 2,600 ft^2 will be supported by two 60-inch diameter drilled shafts. Steel casings for the drilled shafts will be installed using a vibratory hammer. Installing the casings would likely occur over two days. Total construction duration for the drilled shafts will be about two weeks. An overhead loading structure measuring 2,600 ft^2 will be constructed on the west side of the trestle and will be supported by one 131-inch and one 96-inch diameter drilled shaft. Installation of each casing will take about an hour, depending on soil conditions. Construction of the drilled shaft will last about two weeks.

Wingwalls encompassing approximately 900 ft^2 will be constructed on either side of the seaward end of the transfer span. Fourteen 36-inch diameter steel piles and four 18-inch steel piles will be used to support each of the two wingwalls, for a total of 18 piles. Fixed dolphins will be constructed just beyond the wingwalls using a total of eighteen 30-inch steel piles (9 per structure), installed with a vibratory hammer. It will take approximately 30 minutes to install each pile; pile installation will last about six days.

A replacement fishing pier will be built just east of the new terminal and cover approximately 3,455 ft^2. The pier will be supported by twelve 24-inch diameter concrete piles that will be installed using an impact hammer. About thirty-seven 12-inch diameter steel piles will also be installed for fenders and guide piles. The steel piles will be vibrated into place and do not require proofing with an impact hammer.

A floating barge measuring 50 ft by 150 ft (7,500 ft^2) will be anchored adjacent to the new terminal to support cranes, pile driver, and other construction equipment. The barge will be anchored with two 2 ft by 2 ft spuds for the duration of construction (one in-water work season). The barge will be moved periodically to access different work areas. A floating dolphin measuring 85 ft by 54 ft (4,600 ft^2) will be relocated from the existing terminal and anchored adjacent to the new terminal.

Directional lighting for operation of the facility will be installed on the trestle and transfer span. Light will be directed onto the structures themselves and not into the water, to minimize light spillage from these structures. Shielding will also minimize light spillage.

The Project also proposes to construct a new terminal building (4,000 ft^2 on the first level and 12,500 ft^2 on the second). About 2,600 ft^2 of the second story footprint will extend over the mean higher high-water (MHHW). The building will be constructed on a pile foundation consisting of eight 24-inch diameter concrete piles (in the intertidal zone) and fifty steel H or 12-inch diameter piles (driven in upland areas).

As a result of extending the SR 525 roadway to the new terminal and expansion of paved areas to accommodate exit lanes, turning and holding areas, the Project will create approximately 10.2 acres of new pollution-generating impervious surface (PGIS); no significant area of PGIS will be removed, though a small amount may be removed to accommodate decorative planting strips. Runoff from the Project will be captured by shrub/tree vault treatment catch-basins with piping from the catch-basins to either outfalls or to bioretention areas and will receive enhanced treatment via Filterra cartridges. To avoid or minimize conflicts with groundwater, the shell midden, or soil contaminants, slope depth of piping will be minimized in order to avoid deep trench excavations.

The FTA and WSF have agreed to implement a hydroacoustic monitoring plan for the purposes of determining sound pressure levels (SPLs); a marbled murrelet monitoring plan according to current USFWS protocol; and reporting and adaptive management, to minimize Project impacts.

Structure removals (existing ferry terminal, fishing pier, and Tank Farm Pier), and construction of a new ferry terminal and associated infrastructure will result in permanent and temporary impacts to intertidal substrates, native benthos, and water quality. The new overwater structures will consist of steel and concrete components. Improvements to the stormwater conveyance and treatment systems will include enhanced treatment for all new pollution generating impervious surface (PGIS), new catch basins and, proprietary treatment systems (Filterra, or another approved equivalent device) that discharge to new or existing outfalls, or to bioretention areas. The FTA and WSF have committed to proper cleaning, maintenance and or replacement of proprietary treatment systems in perpetuity, as well as quarterly sweeping of PGIS using a high-efficiency vacuum sweeper.

The Project will reduce the total amount of overwater structure by 129,132 ft^2. The Project will construct a pier large enough to accommodate the new 144-vehicle ferries that will replace existing 124-vehicle ferry boats. These larger vessels will allow for additional passengers and vehicles due to their increased volume, but the level of ferry service (i.e. trips per day), the level of service provided by associated roadways, and daily traffic patterns, are not projected to change significantly over time. The holding lanes associated with the existing terminal and portions of the Tank Farm site that are not affected by this Project will likely be redeveloped. However, no permits or building moratoria are tied to the Project, and no indirect effects to the pattern or rate of land use conversion are foreseeable and reasonably attributable to the Project.

Sufficient information has been provided to determine the effects of the Project to marbled murrelet and to conclude whether the Project is likely to adversely affect that species. Our conclusion is based on information in the Form and Reference Biological Assessment, successful implementation of the BMPs and Minimization Measures, and the following rationale:

Marbled Murrelet

The action area provides suitable marine habitat for the marbled murrelet and is known to support low to moderate numbers during both the summer and winter months. Based upon location and baseline environmental conditions, we expect that marbled murrelets use the nearshore waters near Mukilteo and may be present in low to moderate numbers during construction and operation.

Noise

Construction activities, especially impact pile driving and proofing, will result in increased in-air and underwater sound. Resulting underwater SPLs and in-air sound levels will be temporary and intermittent, totaling up to 3.75 total hours per day for 9 days installation of 24-inch diameter concrete piles. The Project proposes to impact pile drive thirty-four 24-inch diameter piles. The increases in underwater sound are expected to result in SPLs that could cause injury (>183 dB cumulative sound exposure level (SEL).

We are not aware of instances where vibratory pile driving has caused injury to diving birds. Likewise, there is no documentation of impact installation of concrete piles causing injury. The wave forms generated by impact installation of concrete piles exhibit a longer rise time, and we expect that they are inherently less likely to cause barotrauma or damage to hearing, and other physical injury. We conclude that vibratory pile driving and impact installation of concrete piles pose a risk of injury that is far less than that associated with impact driving or proofing of hollow steel pipe piles.

During impact pile driving, the zone of potential injury is so small that the likelihood of exposure is discountable. The zone of potential non-injurious threshold shift for foraging marbled murrelets, is associated with, would extend up to 33 meters from each pile. WSF has committed to shore-based monitoring for marbled murrelets during impact pile driving activities to minimize exposure. Based on the incorporated minimization measures (including marbled murrelet monitoring), the small area of impact, and short duration of impact pile driving activities (up to five 45-minute events per day, interspersed over 2-hour periods, occurring over two work weeks between December 2015 and February 2016), it is extremely unlikely that marbled murrelets will be exposed to SPLs that could result in injury. With monitoring, the probability of a marbled murrelet encounter within the 33-meter area, within which underwater sound levels could exceed 183dB SEL, over the 9 day period, is 0.0527 or lower. Therefore Project-related effects resulting from pile driving activities are considered discountable.

In the long term, operation of the ferry terminal will result in on-going noise impacts within the action area associated with ferry boats. Despite an increase in anticipated ridership in the future, there is not a direct correlation between increased ridership and increased ferry trips for the following reason: the multimodal functions of the new terminal will allow for more efficient use of the ferry by non-vehicle commuters and public transit users, the larger ferries that will be supported by the new terminal facilities will accommodate a larger number of vehicles per trip, limiting the total number of ferry trips per day to levels similar to current conditions. Noise levels associated with the new ferries are similar to and possibly lower than current ferry boats.

As a result, noise levels generated by ferry traffic within the action area are anticipated to remain relatively constant, but the location of the noise will change from the existing ferry terminal and route to the proposed terminal location and route. This change in location will not measurably alter baseline conditions or generate new impacts to marbled murrelets within the action area. Therefore, noise effects resulting from ongoing ferry operations are considered insignificant.

Water quality

Installation and removal of piles, installation of stone columns, and dredging will result in temporary impacts to water quality. Based on the Form and supporting modeling reports (Coast & Harbor Engineering, 2012a), during vibratory installation and removal of piles, increased turbidity and/or resuspended contaminants surrounding the piles will be confined to within 150 ft of the piles.

One recent study (Weston Solutions and Pascoe Environmental Consulting 2006) indicated that elevated total suspended solids were generally confined to within ten meters of pile removal activities and would be temporally limited to a short time period (~five minutes). Authors observed oily sheens or slicks form as piles were removed and elevated polycyclic aromatic hydrocarbons (PAH) concentrations persisted five minutes after piles were pulled; however, the study states that the ability to determine trends over time were limited by tug and barge activities. This same study measured marked decreases in PAH concentrations in surrounding sediments approximately one month after piles were removed.

Smith (2007) measured concentrations of PAHs in surface water and surface sediments resulting from creosote-treated post removal. The author measured changes in PAH concentrations in these media pre-and post-removal and over a longer time period. The author observed bubbles of oily liquid rising from the sediment and forming a slick on the surface water up to one hour after posts were removed. Before post removal, total PAH concentrations in surface waters were 1.1 $\mu g\ 1^{-1}$. Thirty seconds after post removal, PAH concentrations in surface water were 101.8 ± 8.3 $\mu g\ 1^{-1}$. Sixty seconds after removal, the total PAH concentration was 22.7 ± 4.8 $\mu g\ 1^{-1}$. Total PAH concentration in surface sediment (taken 50-100 mm from the piles at surface and 200mm depth) before post-removal was 24.1 and 31.2 mg kg^{-1} dry weight, respectively. Post-removal concentrations measured at the same locations and depths were 45.5 and 70.3 mg kg^{-1} dry weight five minutes after removal, and 59.7 and 75.0 mg kg^{-1} dry weight six months after removal. The Smith (2007) study shows that when creosote–treated posts were pulled out, there was a release of PAHs to the environment as well as long-term increases in PAH concentrations in surface sediments.

Given the limited PAH concentration information available for the Project site, it is difficult to predict with any accuracy what concentrations will be in surface waters and sediments during pile removal, but it is reasonable to assume PAH concentrations in the water column will be elevated for a period of time, at least one hour, within the 150-foot radius of pile removal activities, throughout the entire duration of these activities, as a result of resuspension of contaminated sediments and potentially pooled creosote. It is also reasonable to assume that there will be short- and long-term elevated concentrations of PAHs in surface sediments in the vicinity of removed piles.

For the existing terminal, pile removal activities will occur for 73 hours over a period of two weeks during the third in-water work window (July 15 to February 15). For the Tank Farm Pier, pile removal activities will occur over a large area (3.17 acres) and take ten months, split between two shorter in-water work windows (September 1 to February 15), as negotiated with NMFS. Direct exposure to suspended sediments in the water column from pile removal would be limited to these time periods. There is little literature documenting the effect of sediment on forage fish in the marine environment. Forage fish spawn and rear along naturally turbid shorelines and are frequently exposed to natural sediment plumes entering Puget Sound via freshwater tributary streams (U.S. Fish and Wildlife Service 2008, p. 19). We do not expect temporary turbidity or suspension of sediments and the permanent habitat alterations to impact the marbled murrelet prey base to a measurable extent.

Direct exposure to elevated PAH or contaminant levels in the water column would be limited temporally and spatially to the extent specified above for turbidity. Indirect exposure to elevated contaminants via consumption of prey species (forage fish) that ingest contaminants directly from the water column or via consumption of benthic prey species inhabiting contaminated sediments would potentially extend over a longer period of time (months). Direct or indirect exposure to creosote-related contaminants is expected to be limited to a very small area (within 150 ft) of pile removal activities. Marbled murrelet foraging in close proximity (within 150 ft) of the Tank Farm Pier is expected to be very limited given the general lack of suitable forage fish spawning habitat in this area. As a result, potential short or long-term exposures to elevated concentrations of contaminants in the water column or via the food web at this location are considered insignificant. At the existing ferry terminal, suitable forage fish habitat is present. As a result, direct exposure to creosote related contaminants at the existing ferry terminal is possible, but will be limited in duration (73 hours over two weeks), and to within 150 ft of the existing structure. The USFWS expects that any short-term effects from exposure to creosote from piling removal will be immeasurable and therefore considered insignificant. Long-term exposure via the food chain will be limited to this same area. Due to the very limited size of possible impacts to sediments and resultant effects to marbled murrelet prey resources via the food chain we do not expect the marbled murrelet prey base to be affected to a measurable extent.

Stone columns have been located in an area with no known history of contamination. Installation of stone columns also has the potential to resuspend or spread contaminated material (if encountered) and increase turbidity. Stone columns will be constructed over an area of 25,000 ft^2 over four weeks. Pressure created by stone column installation could force soil or groundwater through the ground and into nearshore areas. Modeling conducted for the Project indicates these effects would be unlikely to extend beyond approximately 177 ft from the Project footprint. During stone column installation, turbidity would decrease to 5 Nephelometric Turbidity Units (NTU) above background concentrations at approximately 177 ft. Water quality will be monitored during stone column installation to ensure turbidity and associated contaminants do not extend beyond 150 ft. Direct exposure to suspended sediments and elevated contaminant concentrations (if present) in the water column from stone column installation would be limited to within 177ft from the Project footprint, during working hours over a four

week period. Indirect exposure to elevated contaminants via the food chain at this location is considered unlikely, given the low probability for the presence of contaminants and lack of suitable habitat for marbled murrelet prey species.

Sediments that are resuspended during dredging will settle out of the water column within approximately 150 ft of the dredge prism. During dredging, turbidity would decrease to 3 NTU above background within 150 ft and to background levels within approximately 300 ft. Dredging will occur over a 30 day period. Water quality will be monitored during dredging to ensure turbidity and associated contaminants do not extend beyond 150 ft. Direct exposure to suspended sediments and elevated contaminant concentrations in the water column from dredging would be limited to within 150 ft of dredging activities, during working hours over a four week period. Indirect exposure to elevated contaminants via the food chain is considered unlikely at this location, given the lack of suitable habitat for marbled murrelet prey species.

With proposed BMPs and monitoring, these construction-related temporary water quality impacts will be confined to a small area (150ft for pile removal and dredging and 177 ft for stone column installation) over the time periods described above, and will not have permanent measurable effects on prey species and the quantity or quality of food chain resources available to marbled murrelets in the vicinity of the Project or the action area. Therefore, water quality related effects to marbled murrelets or their prey base are considered insignificant.

Effects to Forage Fish: Habitat

Pacific sand lance (*Ammodytes hexapterus*) (sand lance) is an important forage fish for marbled murrelets and several other species. WDFW PHS data (WDFW 1992) show sand lance spawning beaches in the Project area. Spawning is known to occur approximately 100 ft to the west and more than 800 ft to the east of the Tank Farm Pier. Sand lance have been observed spawning in the vicinity from late November to late February, with peak spawning in mid-January. The distribution of eggs is between +6 ft and +8 ft MLLW, but some eggs were seen at approximately +4 ft MLLW (Port of Everett 2004).

During pile removal, elevated turbidity and PAH or other contaminant concentrations in the water column will occur during known spawning months. However, in the potentially affected area surrounding the Tank Farm Pier (approximately 150-foot radius surrounding pier), forage fish spawning habitat and spawning occurrence are limited, such that measurable impacts to the forage base are not anticipated. In the vicinity of the existing ferry terminal, impacts will be limited to the same 150-foot radius around pile removal activities, but the temporal duration will be very short (a total of 73 hours over a two week time period), such that potential impacts to the forage base will also be immeasurable. Therefore, the USFWS expects that any short-term effects from exposure to creosote from piling removal will be immeasurable and therefore considered insignificant.

Based upon the Form and supporting sediment transport modeling results (Coast & Harbor 2012b), long-term sediment mobilization via wave energy and longshore sediment transport due to removal of the Tank Farm Pier and dredging a portion of the sediment mound that has

accumulated under the pier, is not likely to have a measureable effect on macroalgae or aquatic plant growth in the vicinity of the Project as a result of redistribution of sediments forming a 0.8 inch-thick layer up to 2,000 ft from the Tank Farm Pier. Longer term (six or more months) exposures to contaminants and PAHs via the food chain could extend throughout this area as a result of sediment transport processes redistributing contaminated sediments within it. However suitable forage fish habitat is generally lacking in this sediment redistribution area, significantly limiting the potential for exposure. As a result, we conclude potential impacts to the marbled murrelet via food chain impacts are insignificant. The new location and orientation of the ferry terminal will not measurably affect benthic habitat or shoreline erosion via propwash and vessel wake wash, respectively.

The Project will result in 21,106 ft^2 of overwater cover. However, as a result of removal of existing structures, the Project will result in a net decrease in overwater cover totaling 129,132 ft^2. The existing ferry terminal and fishing pier is located within sand lance spawning habitat. Removal of this structure will result in temporary impacts to sand lance habitat, but will improve long term habitat quality by eradicating overwater cover and creosote treated wood piles from this location. Though pile installation will result in 445 ft^2 of permanent impacts to benthic habitat, the Project as a whole will result in a net gain of 2,870 ft^2 of benthic habitat as a result of pile removal. The new ferry terminal and fishing dock will be located outside of known sand lance spawning habitat.

As a result, effects to marbled murrelets resulting from impacts to forage fish habitats will be insignificant.

Effects to Forage Fish: Stormwater

Increased impervious surfaces, despite receiving enhanced treatment will result in increased pollutant loading to Puget Sound. Increased loads of stormwater constituents will result in long-term incremental degradation of baseline habitat conditions in the immediate vicinity of stormwater outfalls. The potential for these habitat impacts to result in indirect effects to marbled murrelets as a result of impacts to forage fish or forage fish spawning, is considered insignificant because the size of anticipated plumes or dilution zones for stormwater outfalls is very small (less than 21 ft for outfall #4-24, 47 ft for #5-30, and 16 ft for #6-XX); the discharge points for outfalls #5-30 and #6-XX are located outside suitable or documented forage fish spawning habitat, and the discharge point for outfall #4-24 is located approximately 50 ft waterward of suitable/documented spawning habitat. Stormwater concentrations for all stormwater constituents will be reduced as a result of the proposed treatment. Once treated stormwater is discharged to Puget Sound, modeled dilution distances for the pollutants of concern (dissolved copper and zinc) range from 4.7 to 19.1 ft for dissolved copper and from 15.5 to 46.2 ft for dissolved zinc. Within these distances, fish could be exposed to elevated pollutant levels. Due to the limited affected area, indirect effects to marbled murrelets resulting from effects to forage fish are considered insignificant.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Washington State Department of Transportation, WSF and the FTA are proposing the Project to improve the operations and facilities serving the mainland terminus of the Mukilteo-Clinton ferry route. The Mukilteo Ferry Terminal is located in the City of Mukilteo, Snohomish County, Washington. The terminal is located in Township 28 North, Range 4 East, Section 3, in Possession Sound. The new terminal would be approximately 1,700 ft east of the existing terminal in Township 28N, Range 4E, Section 33.

The ferry route is part of SR 525, the major transportation corridor crossing Possession Sound, the portion of Puget Sound that separates Whidbey Island from the central Puget Sound mainland. In 2011 the Mukilteo-Clinton route was WSF's busiest route for vehicle traffic and had the third highest total annual ridership, serving almost four million total riders.

The purpose of the Project is to provide safe, reliable, and effective service and connection for general purpose transportation, transit, high occupancy vehicles, pedestrians, and bicyclists traveling between Island County and the Seattle/Everett metropolitan area and beyond. The Mukilteo ferry terminal has not had significant improvements for almost 30 years and needs key repairs. The existing facility is deficient in a number of aspects, such as safety, multimodal connectivity, capacity, and the ability to support the goals of local and regional long range transportation and comprehensive plans. The Project is intended to:

- Reduce conflicts, congestion, and safety concerns for pedestrians, bicyclists, and motorists by improving local traffic and safety at the terminal and the surrounding area that serves these transportation needs.

- Provide a terminal and supporting facilities with the infrastructure and operating characteristics needed to improve the safety, security, quality, reliability, efficiency, and effectiveness of multimodal transportation.

- Accommodate future demand projected for transit, high occupancy vehicles, pedestrian, bicycle, and general purpose traffic.

Construction is scheduled to begin in 2015 and last for approximately two years. In-water work generally will occur during the in-water work window established by the Washington Department of Fish and Wildlife for the Project, July 15 to February 15. Some specific work elements will occur during shortened in-water work windows, specifically Tank Farm Pier pile removal (September 1 to February 15) and dredging activities (November 1 to February 15). The Project will take place over three in-water work seasons. Specific marine and upland components of the Project are described in greater detail below.

Marine Components

The Project will remove a 138,080 square-foot (3.17 acres) over-water pier structure containing approximately 3,900 creosote-treated piles. Demolition of the Tank Farm Pier will remove approximately 7,300 tons of creosote-treated timber from the aquatic environment. Demolition will take approximately ten months over two years.

Removal of the pier will occur from land and also from a barge containing the necessary equipment. Pile removal will begin at the dredge prism, then move to the seaward side of the pier, which is approximately 600 ft offshore, and gradually move inland as work progresses. Pile removal outside the dredge prism will occur between September 1 and February 15. Piles will be removed with a vibratory hammer. The crane operator will take measures to reduce turbidity, such as vibrating the pile slightly to break the bond between the pile and surrounding soil, and removing the pile slowly. If piles are so deteriorated they cannot be removed using vibratory methods, the operator will use a clamshell to pull the piles from below the mudline, or cut at or up to two feet below the mudline (depending on the depth of the pile if broken and whether or not sediments are contaminated) using a pneumatic underwater chainsaw. Per the BMPs specified in the Form and the Reference BA, holes left by removed piles will be filled with clean material to restore the substrate surface, containment booms will be used to prevent the spread of any oil or wood scraps, and water quality and turbidity monitoring will be employed. Due to the density of piles at the Tank Farm site, the Project proponent may cap the entire berm beneath the Tank Farm Pier with clean sediments, rather than fill individual holes, to minimize long-term resuspension (i.e. wicking or bubbling of creosote into the water column) or to cover potentially contaminated sediments surrounding creosote piles.

The Project will dredge an area approximately 500 ft long by 100 ft wide to a depth of up to -30 MLLW (about 23,500 cy) to provide a navigation channel through the sediment mound underneath the Tank Farm Pier. The landward edge of the dredge prism is approximately 230 ft offshore, and extends northeast to about 410 ft offshore. Dredging will last less than a month, and is currently scheduled to occur between November 1, 2015 and February 15, 2016 when listed salmonids are least likely to be present in the action area. Several BMPs will be deployed during dredging to limit turbidity, such as removal of piles from the dredge prism prior to dredging (to ensure smooth operation of the bucket), controlling the bucket speed, and turbidity and water quality monitoring.

Spoils will generally be disposed of offshore in compliance with DMMP standards. Any dredged material that exceeds DMMP criteria will be removed and disposed of at existing upland commercial facilities permitted to accept contaminated waste. Transport of contaminated material will use existing haul routes, such as state highways.

To reinforce, densify, and provide drainage of potentially liquefiable soils, approximately 200 3-foot diameter stone columns, extending 60 ft below ground surface, will be installed in a grid pattern (with row spacing ranging from five to ten feet) underneath the trestle, transfer span, and overhead loading structure over an area of approximately 25,000 ft^2. A vibratory probe will be used to penetrate to the design depth and approximately 3,142 cy of gravel will be fed into the

soil. Compressed air or water is used to push the gravel through the feeder tube and into the subsurface. Construction of the columns will take approximately eight weeks. The area of stone column installation has been located to avoid contaminants of concern in the Project area.

A new concrete trestle measuring 1,600 ft^2 will be supported by fourteen 24-inch diameter octagonal concrete piles that will be installed using an impact hammer. It will take as long as two hours to place and drive each pile over the course of five days. A floating barge measuring 50 ft by 150 ft (7,500 ft^2) will be anchored adjacent to the new terminal to support cranes, pile driver, and other construction equipment. The barge will be anchored with two 2-foot by 2-foot spuds for the duration of construction (one in-water work season). The barge will be moved periodically to access different work areas.

The new transfer span will measure approximately 2,600 ft^2 and will be supported by two 60-inch diameter drilled shafts. Steel casings for the drilled shafts will be installed using a vibratory hammer. It will take approximately one hour to drive each casing based on known soil conditions. Casing installation could take longer if an obstruction is encountered. Installing the casings would likely occur over two days. Total construction duration for the drilled shafts will be about two weeks.

Directional lighting for operation of the facility will be installed on the trestle and transfer span. Light will be directed onto the structures themselves and not into the water, to minimize light spillage from these structures. Shielding will also minimize light spillage.

An overhead loading structure measuring 2,600 ft^2 will be constructed on the west side of the trestle and will be supported by one 131-inch and on 96-inch diameter drilled shafts. As with the transfer span, the shaft casing will be vibrated into place. Installation of each casing will take about an hour, depending on soil conditions. Construction of the drilled shaft will last about two weeks.

Wingwalls encompassing approximately 900 ft^2 will be constructed on either side of the seaward end of the transfer span. Nine 18-inch steel piles will be used to support each of the two wingwalls, for a total of 18 piles. Fixed dolphins will be constructed just beyond the wingwalls using eighteen 30-inch steel piles. All of these piles will be installed with a vibratory hammer. Because the dolphins and wingwalls are not load-bearing structures they will not need to be proofed with an impact hammer. It will take approximately 30 minutes to install each pile; pile installation will last about six days.

A floating dolphin measuring 85 ft by 54 ft (4,600 ft^2) is anchored at the existing terminal. The dolphin will be relocated from the existing terminal and anchored adjacent to the new terminal.

The existing terminal, comprised of 8,120 ft^2 of overwater cover and containing 248 creosote-treated piles, will be demolished in a third in-water work season, resulting in removal of approximately 406 tons of creosote-treated timber from the aquatic environment. Demolition will take approximately two weeks and will occur from land and from a barge during the July 15 to February 15 work window.

The Port of Everett public fishing pier/seasonal day moorage is just east of the existing terminal and shares part of its foundation with the existing terminal. The pier is over 2,000 ft^2 and contains forty-two 12-inch diameter creosote-treated timber piles. The pier will be removed when the existing terminal is demolished; removal of both structures will take about two weeks. The existing terminal and fishing pier will be removed using both land and barge-based equipment.

A replacement fishing pier will be built just west of the new terminal and cover approximately 3,445 ft^2. The pier will be supported by twelve 24-inch diameter concrete piles that will be installed using an impact hammer over a four day period. About thirty-seven 12-inch diameter steel piles will also be installed for fenders and guide piles. The steel piles will be vibrated into place and do not require proofing with an impact hammer.

Upland Components

The Project also proposes to construct a new terminal building (4,000 ft^2 on the first level and 12,500 ft^2 on the second). About 2,600 ft^2 of the second story footprint will extend over the MHHW. The building will be constructed on a pile foundation consisting of eight 24-inch diameter concrete piles (in the intertidal zone) and 50 steel H or 12-inch diameter piles (driven in upland areas).

As a result of extending the SR 525 roadway to the new terminal and expansion of paved areas to accommodate exit lanes, turning and holding areas, the Project will create approximately 10.2 acres of new PGIS; no PGIS will be removed. Stormwater from the existing terminal vicinity currently discharges untreated to Possession Sound. Runoff from the Project will be captured by shrub/tree vault treatment catch-basins with piping from the catch-basins to either outfalls or to bioretention areas and will receive enhanced treatment via Filterra cartridges. Stormwater from the new terminal will be discharged via three outfalls: an existing outfall in the vicinity of Brewery Creek, an existing 30-inch diameter outfall, and a new outfall that will be constructed on the eastern edge of the site. The west end of the site will be routed to the existing 24-inch pipe outfall. The center of the site will be routed to an existing 30-inch outfall. Water from the eastern portion of the site will be routed to a new outfall. To avoid or minimize conflicts with groundwater, the shell midden, or soil contaminants, slope depth of piping will be minimized in order to avoid deep trench excavations.

Conservation Measures

WSF's general Construction Minimization Measures, are provided in the WSF Biological Assessment Reference document Section 2.3 (pp. 73-80) and are incorporated here by reference. Additional Project specific BMPs that will be implemented include those listed in the *Minimization Methods* section of the Form (WSF 2012), and are incorporated here by reference. However, to ensure in-water Project turbidity and elevated levels of suspended sediment or resuspended contaminants are confined to within 150 ft of piles, dredge prism, and 177 ft of stone columns, the following BMPs and monitoring protocol will be implemented:

The specifications will require that the Contractor develop a demolition and dredging plan that details the BMPs to be used and water quality monitoring procedures in accordance with the project permits. Chemical analytical and turbidity monitoring results will be used to evaluate potential construction activity impacts to the water column and sediment surface at the 150 ft compliance radius that may trigger work stoppage and the implementation of additional BMPs. Plans will be submitted to the following agencies for review and approval prior to beginning work: WSF as well as the Washington State Department of Ecology (Ecology). BMPs will include (but are not limited to):

- Dredging with a closed environmental bucket,
- Slow bucket speed during dredging,
- Split-hulled dredge material barges will be sealed and prohibit the release of untreated water,
- Absorbent booms will be in place to minimize impacts from potential releases that may occur during demolition or construction activities,
- In-water construction operations will be observed by a WSF representative at all times,
- Vibratory pile removal will be used to reduce sediment disturbance,
- Removed wood and adhered sediment will be disposed of at an approved upland facility,
- The outflow velocity of the water /air jet during stone column installation will be decreased if turbidity monitoring indicates a possible exceedance over the water quality threshold values, and
- Turbidity monitoring samples will be collected twice a day from two locations: upgradient from the work area to evaluate background conditions and downgradient from the work area to evaluate impacts from work. Samples will be collected from the surface water, the middle of the water column, and from water two feet above the sediment surface at each location.
- Water column samples will be collected once daily for chemical analyses of PAHs, chlordanes and other contaminants of concern (COCs), if appropriate, based on the results of the dredge material characterization sampling.

The contractor will be required to submit water quality monitoring results daily to WSF for review, to Ecology as specified in permit requirements, and annually to USFWS. It is possible that the frequency of water sampling/chemical analyses could be reduced if sampling indicates that water quality is not being affected by the activity.

The water quality monitoring program will include stopping work immediately and assessing the need for additional BMPs if:

- measured turbidity at the compliance sample locations exceeds the 401 Water Quality Certification and WAC 173-201A-210 water quality criteria of 5 NTUs when the background is less than 50 NTUs or less or a 10 percent increase in turbidity when the background turbidity is greater than 50 NTUs, 150 ft from the work area and/or

- Chemical analytical results for chlordane, PAHs, or other COCs, if applicable, identified based upon the results of the DMMP sediment characterization exceed applicable Washington State Water Quality Standards for Marine Surface Waters.

The need for and type of additional BMPs to be implemented will be discussed with Ecology after exceedances of the water quality monitoring turbidity and/or chemical analytical criteria are observed. Potential additional BMPs may include:

- Silt curtains

- Removable dams

- Sheet-pile enclosures

- Silt screens

- Pneumatic (bubble) curtains

In addition, marbled murrelet monitoring will be implemented during impact pile driving. Pile driving will not occur if marbled murrelets are present within the 33 m monitoring zone (refer to Appendix A (Marbled Murrelet Monitoring Plan).

Interrelated and Interdependent Actions

Interrelated actions are actions "that are part of a larger action and depend on the larger action for their justification"; interdependent actions "that have no independent utility apart from the action under consideration" (50 CFR section 402.02).

The transfer of the Tank Farm property from U.S. Air Force (USAF) ownership to WSF ownership is an interrelated action, in that the transfer of the property would not transpire if construction of the Project was not pursued. The USAF determined this transfer resulted in no effects to listed species or designated critical habitats. There is no requirement for the USFWS to concur on "no effect" determinations. The determinations that the Project will have no effect on these species and critical habitat rest with the action agency.

No measurable effects to bull trout individuals, their prey base, or habitat are expected to result from interrelated or interdependent actions.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment.

Based on the distance at which in-air propagation of pile driving noise attenuates to background levels, the in-air extent of the action area is approximately 10,000 ft (1.89 miles) from the Project footprint over water, and 3,500 ft over land. The in-water extent of the action area is bounded by nearby land masses, most notably Whidbey Island. The area defined by potential in-water noise impacts also includes areas affected by temporary turbidity increases, dilution zones for pollutants in stormwater discharge, and any areas potentially affected by changes in sediment transport as a result of Project activities, as well as the Port Gardner open-water disposal site.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on four components: (1) the *Status of the Species*, which evaluates the bull trout rangewide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the bull trout in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the bull trout; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the bull trout; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the bull trout.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the bull trout current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the bull trout in the wild.

The jeopardy analysis in this Opinion emphasizes consideration of the rangewide survival and recovery needs of the bull trout and the role of the action area in the survival and recovery of the bull trout. It is within this context that we evaluate the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Opinion relies on four components: 1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the bull trout in terms of PCEs, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; 2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; 3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and 4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on bull trout critical habitat are evaluated in the context of the rangewide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

The analysis in this Opinion places an emphasis on using the intended rangewide recovery function of bull trout critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

STATUS OF THE SPECIES

The rangewide status of the bull trout is provided in Appendix B.

STATUS OF CRITICAL HABITAT (BULL TROUT)

The rangewide status of bull trout critical habitat is provided in Appendix C.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress.

The action area associated with the proposed action is padded on the farthest-reaching stressor. This was determined to be the distance that sound generated by the action, specifically underwater and in-air sound generated by impact pile driving, intersects with a land mass or where it attenuates to background levels. For the purposes of this analysis, we have focused our discussion of the environmental baseline on those portions of the action area where bull trout could be measurably affected, in this case, Possession Sound and the waterbodies and environmental conditions affecting the water and habitat quality within it.

Possession Sound and Tributaries

Possession Sound is part of Puget Sound, between Whidbey Island and the coastline of Snohomish County. Possession Sound connects the main Puget Sound basin to the south with Saratoga Passage and Port Susan to the north. The Snohomish River flows into Possession Sound at Port Gardner Bay. Within the Project area, Japanese Creek enters Possession Sound through two culverts east of the proposed terminal location. The main discharge point is through a 48-inch culvert underneath the Mount Baker Terminal, approximately 2,500 ft east of the proposed terminal location. A smaller pipe discharges in front of the Tank Farm. The pipe has been buried by recent storms but may still discharge water subsurface. Brewery Creek enters Possession Sound approximately 1,200 ft west of the proposed terminal. Several City of Mukilteo storm drain systems discharge into Possession Sound in the Project vicinity.

Substrate and Slope

Substrates in the vicinity of the proposed terminal are primarily sand and silt. Riprap is found in the high intertidal area, and extends approximately 20 ft from the shore. Substrates underneath the Tank Farm Pier also contain large chunks of concrete that have fallen off the pier, as well as shell hash from shellfish that cover the pilings.

The beach is steeply sloped at this location, dropping to about 30 ft below MLLW within 75 ft of the shoreline. A ship's berth was dredged along the east side of the Tank Farm Pier in the late 1940s and still remains, with elevations east of the pier approximately 38 ft below MLLW. Water is shallower closer to the Tank Farm Pier (-14 MLLW) due to a sediment mound that has accumulated underneath the pier. The mound may have been formed by sediments that drop out of seawater as wave energy is attenuated by the dense placement of pilings underneath the pier, it may have been created deliberately to provide support for the pier, or it may have resulted from placement of dredge material from the dredge channel.

Groundwater Characteristics

Groundwater levels beneath the Tank Farm property are about seven to 10 ft below the surface elevation. Levels vary with tidal conditions, and range from +6.1 ft above MLLW at low tide to +11.3 ft MLL at high tide. During low tide, groundwater flows north towards Possession Sound; at high tide groundwater reverses direction and flows south. Groundwater is recharged by onsite and offsite infiltration of rainwater, as well as from aquifers in the uplands south of the Project area. Most of the Project area has been paved, which reduces infiltration of surface water and potential transport of contaminants migrating out of the soil and into Possession Sound.

Flows and Currents

Current velocities at the base of the Tank Farm Pier are fairly small, around 0-0.5 ft/sec, with a maximum of approximately 1.6 ft/sec. Currents run primarily east and west: they flow east during a flood tide and west during ebb tides. Flood tides are stronger than ebb tides. North-south currents are short in duration and small (less than 0.2 ft/sec; Coast & Harbor 2012b).

Land Use

Land uses within the action area are varied. Land uses within the include the existing Mukilteo ferry terminal, a public fishing pier, bus transit facilities, Mukilteo Station, and the Mukilteo Tank Farm with the National Oceanic and Atmospheric Administration (NOAA) Mukilteo Research Station and the Tank Farm Pier. Land north of the Project area includes residential and commercial buildings, including a condominium, several restaurants and retail businesses, and a hotel (the Silver Cloud Inn). Land west and southwest of the Project area is used for the Mukilteo Lighthouse Park, consisting of a public beach, picnic facilities, the Mukilteo Lighthouse and associated structures, and parking. South of the Project area are the BNSF Railway corridor and then residential and commercial areas consisting of numerous single and multi-family residences, retail and commercial businesses, churches and other community services, and restaurants. East of the Project area is the Port of Everett's Mount Baker Terminal, a marine-to-rail intermodal facility, which includes a small public shoreline park and associated parking.

Upland habitats have been heavily influenced by the area's land use history. Much of the Project area consists of pavement or is denuded of vegetation. However, ornamental vegetation and pockets of native vegetation persist in some nearby locations. Vegetation on the Tank Farm property is almost entirely non-native and consists of small trees, shrubs, and herbaceous plants, although there are some small native black cottonwoods (*Populus trichocarpa*) and red alders (*Alnus rubra*) on the site. Extensive pockets of native vegetation are present in Japanese Gulch, Brewery Gulch, and Edgewater Creek Gulch, off the Tank Farm property.

Contaminants and Associated Remediation

The vast majority of the proposed activities will take place on the Tank Farm property, a former bulk fuel storage and distribution terminal. The Tank Farm property, along with several others in the action area have exceeded Federal or state regulatory standards or been identified as

potential contamination sites (Herrera, 2003b). The Tank Farm facility was identified in the Federal Comprehensive Environmental Response, Compensation, and Liability Information System list and the Ecology State hazardous waste sites and leaking underground storage tanks lists. It was also identified in the *Sediment Cleanup Status Report* (Ecology 2001, 2003) as a sediment cleanup site located in the Everett/Port Gardner area. The USAF Fuels Laboratory, located in the center of the site, was identified on the Federal Comprehensive Environmental Response, Compensation, and Liability Information System and Resource Conservation and Recovery Information System-Small Quantity Generator lists. Petroleum-affected soil and ground water are the main concern for both the Tank Farm site and the USAF Fuels Laboratory site. Monarch Painting Corporation was identified as a potential environmental concern because of its sandblasting activities that occurred and the potential of residual petroleum and metals contamination in sandblasting sludge left on the site. The former McConnell's Boathouse, identified on Ecology underground storage tank, Voluntary Cleanup Program, and Washington Independent Cleanup Report lists, was identified as containing petroleum-affected soil and ground water west and adjacent to the Defense Fuel Support Point Mukilteo site. This site was reported as cleaned up in 1998. The City of Mukilteo Public Works Shop was listed on Ecology leaking underground storage tank, underground storage tank, and Recovery Information System-Small Quantity Generator lists. No contaminants or affected media were reported, but based on review of Ecology site file, it is presumed that petroleum would be the primary contaminant.

The Tank Farm site consists of approximately 21 acres of upland commercial and waterfront property and 13 acres of adjacent offshore property. The facility is built on fill material overlying the original shoreline beach deposits. A protective riprap wall, approximately 10 ft high, separates the site from Puget Sound, with the tidal flats and intertidal beaches exposed north of the site during low tide. A brief history of the Tank Farm property is provided below.

In the early 1900s, the Crown Lumber Company operated a lumber mill at the Tank Farm site, along with several smaller-sized shake shingle mills, which were located in the eastern portion of the site (Herrera, 2003b). Several structures, including two hotels and two grocery stores, occupied the western and southwestern portions of the site adjacent to Park Avenue (Sanborn 1912, 1929). The Crown lumber mill closed in the late 1920s; during demolition of the facility in 1931, the remaining structures were destroyed by fire (Ebasco 1992).

During World War II, the site was used by the U.S. Army to load ammunition onto ships bound for the Pacific theater (EDGe 1989, Herrera, 2003b). Based on the review of a 1947 aerial photograph, it appeared that loading of ammunition and other related activities were conducted at the west end of the site. Onsite structures at the time included administration buildings, facilities consistent with vehicle maintenance structures (using oil, diesel, gasoline, and lubricating oils), an ammunition repair shop, several railroad spurs running the length of the site, coal-fired equipment, a pile-retaining wall, and two piers (the fueling pier and a former trestle pier at the eastern end of the property [Kroll 1952]) (Walker 1947; Parsons 1951). Crates of ammunition were reportedly lost over the side of the pier during ship-loading operations (Ebasco 1992; Weller 1991).

In 1951, the USAF acquired the former ammunition depot and converted it to a bulk fuel storage and transfer terminal (CENPS 1950, Herrera, 2003b). Fill material was added, as necessary, to allow expansion of the facility (Walker 1955; GTI 1994). Ten bulk aboveground storage tanks

and an associated network of piping, fuel filters, and pumping systems were installed. Two of the tanks (Tanks 1 and 2) had capacities of 55,000 barrels (2.3 million gallons) each, and the remaining tanks (Tanks 3 through 10) had capacities of 80,000 barrels (3.4 million gallons) each. The USAF began operating the bulk fuel storage and transfer facility in 1953 and continued until 1973, supplying jet propellant no. 4 (JP-4) and aviation gasoline fuels to military installations in the Pacific Northwest (GTI 1994). Fuel was delivered to the site by barge and was distributed by barge, railcar, and tanker trucks. Barge and railcar deliveries were transferred to and from the bulk storage tanks at the fueling pier that extends into Possession Sound; tanker truck deliveries were transferred at two truck-loading docks. The USAF Aerospace Fuels Laboratory began operating on the site in 1955 (Walker 1955).

Prior to 1965 (AEHA 1984), sludge generated during tank cleaning operations (every 3 to 5 years for each tank) was reportedly disposed of in pits located in the truck turnaround area (also known as the spoils area) east of Tank 10 (Herrera, 2003b). When onsite sludge disposal was discontinued, sludge was reportedly disposed in a landfill at Paine Field. The sludge was an oil-and-water mixture of residual fuel, sandblasting grit, tank scale and oily grit, and rinse water (AEHA 1984). Tank bottom sludge had elevated concentrations of heavy metals not present in fuel (AEHA 1984).

By the mid-1960s, the railroad pier extending from the east end of the facility had been demolished and removed, and a small pier was added at the west end of the facility extending into Possession Sound from the administration buildings (the current NOAA facility). This pier was reportedly used for mooring rescue boats to retrieve downed pilots training over Puget Sound (Herrera, 2003b).

In 1972, NOAA began operating in the former administration buildings. In 1973, the USAF permitted the land and facility to the Defense Logistics Agency, which continued operating it as a government-owned, contractor-operated fuel storage and transfer terminal. By the late 1970s, the fueling pier had fallen into disrepair and was no longer used for loading fuel onto railcar tankers (Ebasco 1992; AEHA 1984). By 1979, automatic foam firefighting systems had been added to the tanks (Ebasco 1992, Herrera, 2003b).

In 1981, Tank 10 was taken out of service because of a fuel leak discovered in 1980. In the same year, Tanks 1 and 2 were converted from aviation gasoline to JP-4 storage. By 1982, a fuel recovery well (designated as RW1) had been installed between the USAF Fuels Laboratory and the main oil/water separator (AEHA 1984). In 1986, concrete floors were added to the tank containments (Ebasco 1992). In 1987, the government decided to close the Mukilteo Tank Farm facility and consolidate its mission with the fuel facility in Manchester, Washington (EDGe 1989).

By May 1990, all fuel storage and transfer operations at the site had ceased (Ebasco 1992). The Defense Logistics Agency entered into a remedial action order with Ecology requiring a remedial investigation/environmental assessment/feasibility study (RI/EA/FS) of releases or threatened releases at the Defense Fuel Support Point Mukilteo site (OAG 1990). In 1991, several underground storage tanks were removed from the site. Also during this year, preliminary site investigations began (Herrera, 2003b).

In 1993-1994 remedial site assessments and feasibility studies began. The USAF Fuels Laboratory area (designated as Area 1) was found to have soil, ground water, and floating product contamination. The area containing Tanks 8, 9, and 10 (designated as Area 2) was found to have soil and ground water contamination. No significant impacts were identified in the central portion of the site between Tank 3 and Tank 7 (designated as Area 3) (GTI 1994, 1995).

In spring of 1994, a sediment and shellfish investigation was conducted along the shoreline of the Tanks Farm site to determine the potential environmental impacts associated with releases of contaminants to the marine environment and the human health risks associated with consumption of shellfish from the site (Tetra Tech 1994). Bioassay tests indicated toxicity to marine infauna in certain areas. Subsequent chemical analysis of those sediments indicated that none of the analyzed compound concentrations exceeded the Sediment Quality Standards (SQSs) of the Sediment Management Standards. Since observed sediment toxicity could not be attributed to a specific chemical agent, sediment cleanup standards for the site were based on SQS criteria. A metals analysis of composite clam samples indicated all but 2 of 23 metals (antimony and thallium) were detected at relatively low concentrations. Three constituents were detected in tissue samples (benzoic acid, phenol, and pyridine) at concentrations above method detection limits. Two pesticide compounds, alpha-BHC and gamma-BHC (lindane), were detected in tissue samples at concentrations equal to or slightly above laboratory reporting limits. No PCBs were detected in any of the tissue samples analyzed (Herrera, 2003b).

Following the completion of site characterization, risk assessments, and feasibility studies in 1994, remediation treatment systems, including soil vapor extraction, air sparging, and product recovery systems, were installed across the western (Area 1) and eastern (Area 2) portions of the property. No significant petroleum contamination in soil or ground water was found in the central portion of the site (Area 3); therefore, no remedial system was installed. In 1997, all 10 bulk fuel storage tanks were demolished and removed from the site (GTI 1998) and remedial system startup occurred. Also in 1997, performance monitoring of ground water and surface water on the site was initiated to determine the effectiveness of the systems. The Area 2 remediation treatment system was shut down in November 2000, and the Area 1 system was shut down 2 years later, after performance monitoring data for ground water from each area indicated contaminants were either not detected or found at concentrations below regulatory cleanup levels. Following the shutdown of the remediation systems, compliance monitoring began in each area for ground water, surface water (ground water seeps), soil, and marine sediments. Ecology stated that no further monitoring was required and monitoring wells could be abandoned in 2006 (Herrera, 2003b). Residential development is restricted on the property (WSF 2013); however, the site was removed from the Ecology Hazardous Sites List in 2008 (Herrera, 2003b).

Water Quality

Water quality in Possession Sound is described in the *Status of Bull Trout Critical Habitat in Action Area* section below.

Sediment Quality

Sediment samples collected in 2003 along the Tank Farm property shoreline did not detect contaminants of concern above reporting limits or above Ecology's SQS. However, in 2009 composite tissue samples for mussels exceeded National Toxics Rule criteria for PCBs and polycyclic aromatic hydrocarbons (PAHs; Ecology 2010).

Core sediment sampling underneath and adjacent to the Tank Farm Pier in March and April of 2012 revealed levels of contaminants slightly above DMMP screening level criteria. Upper levels of sediment (from 0-8 ft below ground surface) were found to contain chlordane, an organochlorine pesticide. PAHs were found in the 8-12 ft below ground surface core section collected near the northeast end of the pier. The sediment samples were collected approximately three to five ft from the piles and may not have captured PAHs that could have leached into sediments immediately adjacent to the piles. Higher levels of contamination were found toward the eastern end of the Tank Farm Pier in deeper water.

In addition, the proposed action includes use of the Port Gardner DMMP open-water disposal site(s) in Possession Sound as an interrelated action. Operation of the DMMP site(s) has undergone independent section 7 consultation (FWS Ref. No. 13410-2010-I-0542; *Puget Sound Dredge Disposal Analysis Program*).

Underwater Sound

Underwater Sound was recently measured at the Project site by Washington State Department of Transportation (WSDOT) (Laughlin 2012). Broadband background sound is 124 dBrms cumulative distribution function (50% CDF).

Status of Bull Trout in the Action Area

There are no natal streams in the area of the Project that support bull trout (WDFW 2007).

The aquatic portions of the ferry terminal are within marine foraging, migration, and overwintering (FMO) habitat. Therefore, it is expected that the ferry terminal area would be used by anadromous adult and sub-adult bull trout for foraging, migration, and overwintering (USFWS 2004b). Within the ferry terminal area, it is expected that individual bull trout from the Skagit River (approximately 20 shoreline miles north), Stillaguamish River (approximately 15 shoreline miles north), Snohomish River (approximately 7 shoreline miles north), Lake Washington/Cedar River (approximately 20 shoreline miles south), and the Duwamish/Green River (approximately 30 shoreline miles south) are most likely to be present (WDFW 2007). Bull trout may also be present from rivers and streams in southern Puget Sound (WDFW 2007).

Juvenile and sub-adult bull trout generally exit rivers and migrate downstream between mid-February to early September, with peak migration periods between April and July. Upon entry into saltwater, juveniles may rear in tidal delta marshes or distributary channels, or may pass through into nearshore marine areas (Goetz et al. 2004).

Preliminary study results indicate that subadult and adult bull trout first enter the lower Snohomish estuary and marine nearshore by early to mid-April. Presence in the estuary occurs through mid-summer, after which the bull trout begin moving back to freshwater (Goetz et al. 2004). Bull trout were observed in the lower estuary or marine nearshore the first week of August 2003 (Pentec 2004). This is consistent with bull trout monitoring conducted from late summer through winter 2001 in the Snohomish River. Sampling weekly, no bull trout were collected at stations located at north Jetty Island and Priest Point when the study began in mid-August, through the following winter (Pentec 2004). Two instances of tagged bull trout detections have occurred in the Mukilteo area in the tagging program, both in early summer (Goetz, personal communication 2007). Generally it is believed adult spawners have returned to natal streams by August, with sub-adult fish returning to freshwater into the fall months (Chan, personal communication 2012).

Recently, Goetz et al. identified winter migration of bull trout within the marine environment; subadults and adults leaving their natal basin and entering marine waters in December to migrate to a non-natal river basin to overwinter. Two instances involved fish moving between the Snohomish and Duwamish River, past Mukilteo during the November-January timeframe (Goetz et al. 2012).

Status of Bull Trout Critical Habitat in Action Area

The shoreline in the Project area is within designated bull trout critical habitat (75 FR 63898). In marine nearshore areas of Puget Sound, which includes shorelines in the Project area, critical habitat extends from the MHHW line to -33 ft MLLW.

The PCEs provided in the Project area, and their existing conditions, are described below. PCEs relevant to the terminal area are numbered per the CFR (Federal Register 2010a).

PCE 1) Springs, seeps, ground water sources and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Because it is almost entirely paved, the Project area does not contribute to the recharge of ground water. However, according to the *Snohomish County Groundwater CharacterizationStudy* (EES and Sweet-Edwards/EMCON 1991 as cited in Herrera 2003a p. 14), the Project area (and all of the Mukilteo downtown waterfront area) overlies the northwestern edge of a significant recharge area for the Intercity Plateau aquifer. The prevailing flow direction for this aquifer is to the northwest in the Project area. Shallow ground water likely passes through the Project area, beneath existing pavement, and discharges to the Possession Sound shoreline.

The overall water quality of the Intercity Plateau aquifer historically was considered good (EES and Sweet-Edwards/EMCON 1991 as cited in Herrera 2003a p. 14). However, contaminants in the shallow ground water have been characterized recently as part of the cultural resources investigations on the site.

During previous field investigations, ground water was encountered across the tank farm area between 7 and 10 ft below grade (GTI 1994 as cited in Herrera 2003a p. 14). Water levels fluctuate between 1 and 3 ft daily in response to tidal variations in Possession Sound (AEHA 1982 as cited in Herrera 2003 p. 14). At low tide, ground water flows toward Possession Sound; at high tide, the flow direction is to the south away from Possession Sound. Ground water emerges through the sediment in the tidal zones (WSDH 1991 as cited in Herrera 2003a p. 14). Seepage from surface runoff and precipitation through the permeable fill material and from the upgradient aquifer in the upland area south of the Project area primarily recharge the ground water in this area. Saltwater intrusion occurs in ground water at the tank farm area (Ebasco 1992 as cited in Herrera 2003a p. 14).

The Project is designed to minimize impacts to groundwater. Stormwater facilities will be constructed within areas of clean fill. In excavation areas that reach the groundwater table, groundwater will be characterized prior to construction. Contaminated groundwater will be collected in storage tanks and disposed of at an appropriate facility.

PCE 2) Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent partial , intermittent, or seasonal barriers.

In-water structures include the trestle, the slip and dolphins. The existing ferry terminal may affect fish passage in the nearshore, and may reduce the production of aquatic invertebrates that are prey species to salmon.

Migratory habitat along the nearshore will be improved post-project by removal of overwater cover and piles associated with the Tank Farm Pier. In addition, there will be fewer piles associated with the new trestle and fishing pier compared to the existing structures. Noise from impact pile driving and a reduction of water quality during in-water work could be a temporary barrier to movement along the shoreline.

PCE 3) Abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

There is no large overhanging wood vegetation. The existing conditions within the defined area of critical habitat consist of mostly large and small cobble to the west of the existing ferry terminal, large and small cobble inshore of the MLLW line, and sand/mud with some wood debris to the east of the ferry terminal (MRC 2000). Riprap and seawalls are adjacent to the proposed ferry terminal. Macroalgae occurs in the vicinity; eelgrass is sparse to absent.

There may be a temporary decrease in forage fish habitat quality and water quality due to impacts from pile removal and installation, stone column construction, and dredging. The habitat in the vicinity of the proposed terminal and Tank Farm Pier is generally unsuitable for forage fish and therefore their potential presence is limited. Whereas suitable habitat is present in the vicinity of the existing terminal and fishing pier, but in-water activities (pile removal) will be limited to a very short period of time (73 hours over two weeks). Removal of the existing terminal and the Tank Farm Pier will improve this PCE in the long term.

PCE #4) Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

Complex marine shoreline aquatic environments are rare along the Mukilteo Shoreline. Rip rap and seawalls border most of the shoreline, and there is little overhanging vegetation. Removal of the Tank Farm Pier and redevelopment of the Tank Farm property may present some opportunities to soften the shoreline.

PCE 5) Water temperatures ranging between 2 to 15°C (36 to 59°F), with adequate thermal refugia available for temperatures at the upper end of the range.

East Puget Sound water temperatures can range from 41.4 to 75.7 °F (5.2 to 24.3 °C) with an average of 51 °F (10.58 °C) (Ecology 2007). Water temperature data for specific ferry terminals is not available. The over-water components of the existing and proposed ferry terminals, and the Tank Farm and Fishing Piers (existing and proposed) provide some shade, which may cause slight localized reductions in water temperatures. Removal of the Tank Farm Pier will reduce over-water cover, reducing available shade and associated effects on water temperature.

PCE 8) Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

The marine waters of Possession Sound near the ferry terminal are designated "Extraordinary" for aquatic life use per WAC 173-201(a).

This designation imposes certain restrictions on activities affecting water quality in the Project area as they relate to aquatic life, shellfish, recreation, and miscellaneous uses. For aquatic life, the following criteria must be met:

1. Waters must not exceed 13°C (55.4°F) in any one day
2. The lowest dissolved oxygen level allowed in any one day is 7.0 milligrams per liter (mg/L)
3. Turbidity must not exceed 5 NTU over background when the background is 50 NTU or less, or must not exceed a 10 percent increase in turbidity when the background turbidity is more than 50 NTU
4. Range of pH must be within 7.0 to 8.5
5. A human-caused variation must be within the above range of less than 0.2 unit

In 1996, 1997, and 1998 Possession Sound was identified as having dissolved oxygen concentrations below the state standard for marine waters with excellent quality for aquatic life use. Ecology has included Possession Sound on the 2008 Clean Water Act Section 303(d) list for threatened and impaired water bodies. Possession Sound is listed as Category 2 for

exceedance of dissolved oxygen and fecal coliform bacteria standards. A Category 2 water body of concern is defined as having some evidence of a water quality problem, but not enough to require production of a total maximum daily load pollution control plan. Other water quality parameters monitored in Possession Sound but found to be within water quality standards include ammonia, temperature, and pH (Ecology 2008).

The Washington State surface water quality standards defined by Ecology identify Japanese Creek as protected for the designated uses of salmon and trout spawning, non-core rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values (WAC 173-201A). Water quality data for Japanese Creek indicate that the stream occasionally exceeds the state water quality criteria for fecal coliform bacteria, lead, and turbidity. The creek water quality has also exhibited sporadic exceedances of the state water quality criteria for pH, dissolved oxygen, cadmium, and copper (Herrera 2003a).

Brewery Creek is protected for the designated uses of salmon and trout spawning, noncore rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values, according to the current Washington state surface water quality standards (WAC 173-201A). No water quality data were found for Brewery Creek (Herrera 2003a).

The stormwater system at the existing ferry terminal consists of three drainage areas that drain to Possession Sound. None of the runoff is treated. The first drainage area drains the holding lanes, and consists of a catch basin in the upper holding lane area and two trench drains: one on the northeast side of the holding lanes and one on the east side. The catch basin and trench drains all connect to the City of Mukilteo stormwater system that discharges through an outfall to the east of the terminal area. The second drainage area drains the trestle approach and Front Street, and consists of four catch basins that discharge through an outfall to the west of the trestle. The third drainage area consists of the transfer span (typically 90 ft long by 24 ft wide that carries traffic between the trestle and ferry), which discharges by sheet flow directly to surface water.

At the location of the proposed terminal and associated infrastructure improvements, stormwater runoff is generated in one threshold discharge area, which discharges untreated to Possession Sound through five outfalls. Three of the outfalls are 8-inch diameter drains from the Tank Farm property that drain only non-PGIS. The other two outfalls are 24-inch and 30-inch diameter drains that drain PGIS. There is no information on water quality of discharges from existing outfalls.

Existing creosote treated piles may leach PAHs into the water column, degrading water quality in the vicinity of the existing ferry terminal and also the Tank Farm Pier.

EFFECTS OF THE ACTION

Regulations implementing the Act 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" (50 CFR Section 402.02). This section details the anticipated effects to bull trout from the proposed action.

To describe the potential effects of the action on bull trout and designated bull trout critical habitat, this Opinion applies an approach that first describes the effects to the physical, biotic, and chemical environment (potential "stressors"); the likelihood, intensity, and duration of exposure; the anticipated response(s) to exposure; and then, the biological relevance of those responses for individual bull trout and the PCEs, respectively. Effects at the level of the individual (or group of individuals) are then translated or assessed for significance to numbers (abundance), reproduction (productivity), and distribution at the scale of the larger population(s). For critical habitat, we describe expected temporary and permanent effects to the PCEs and, relative to the recovery role for the larger Critical Habitat Unit and critical habitat rangewide, whether the affected critical habitat will remain functional or retain the current ability to establish (or reestablish) functioning PCEs.

Complex actions that include multiple project elements and/or project locations have the potential to cause a variety of exposures (or exposure scenarios). The sub-sections that follow refer to some of the previously described project elements and items of work as a means of organizing the discussion of potential stressors, exposures, responses, and effects. Though the proposed action will affect a variety of habitats, for bull trout, the affected habitats represent non-core FMO habitat, and only subadult and adult bull trout are likely to be exposed to stressors that elicit a response.

If an effect to the physical, biotic, and/or chemical environment (stressor) would occur at a place or time when exposure of an individual(s) is extremely unlikely, those potential exposures and effects are considered discountable. In general, it is more likely that temporary effects (stressors) and potential exposures can be found discountable. It is more difficult to conclude that permanent or long term effects (stressors) will not expose individuals over time.

If exposure is not discountable and an individual(s) may be exposed to a stressor, the intensity and duration of that potential exposure are important considerations. Some low-intensity and/or short-duration exposures may elicit no response in the individual. Other exposures will or may elicit a response(s), and the biological relevance of those responses must be assessed.

A response is biologically relevant if it measurably affects an individual or a PCE. For example, when stressors elicit an avoidance response and/or prevent or discourage free movement or exploitation of preferred habitats, these responses can have significance for the individual (e.g., reduced foraging success or efficiency, delayed migration). Behavioral responses represent a complex interaction with the affected environment. Determining their biological significance or

relevance requires that we evaluate the condition and needs of the individual(s), the amount and quality of affected habitat, the duration and intensity of exposure, and the action or presence of other stressors.

Measurable adverse effects to individuals may reach the level of take. Take may result if the exposure and effect significantly disrupts normal or essential behaviors (e.g., feeding, moving, sheltering, migrating, spawning, rearing), if it results in significant sublethal physiological stress with potential consequences for growth or long term survival, or if it causes physical injury (e.g., gill abrasion, barotrauma) or mortality.

The sub-sections that follow discuss sequentially: insignificant and discountable effects (by project element and/or item of work); adverse effects to individuals (by project element and/or item of work); effects to the PCEs of critical habitat; and, a synthesis of effects and responses at the scale of the larger population(s) and Critical Habitat Unit. Some common potential stressors are discussed repeatedly (e.g., excess turbidity and sedimentation, effects to the prey base).

Insignificant and Discountable Effects (Bull Trout and Critical Habitat)

This sub-section identifies and discusses in some detail those potential exposures and effects that we conclude are extremely unlikely to occur, and are therefore discountable. This section also identifies and discusses those potential exposures and effects that we conclude will not measurably affect individuals or their habitat, and are therefore insignificant.

<u>Overwater Cover/Shading</u>

Changes in over water cover are described in detail above and summarized here. The new trestle and associated structures will create approximately 15,187 ft^2 of new overwater cover, the new terminal building will increase overwater cover by 2,464 ft^2, and the new fishing pier will result in an additional 3,455 ft^2 of overwater cover; for a total of 21,106 ft^2 post-construction overwater cover. For the fishing pier, a portion of this overwater coverage will be seasonal in nature. The area of permanent overwater coverage of the new fishing pier will be about 2,591 ft^2. Seasonal fishing pier floats for day moorage will be tied to the fishing pier between April and October of each year, covering approximately 864 ft^2. As a result, the total overwater cover associated with the fishing pier is 3,455 ft^2 (worst case). The bathymetry of the shoreline in the immediate vicinity of where new structures will be placed descends quickly to depths that exceed the limits of the photic zone and designated critical habitat, further limiting the impact of overwater coverage in the Project area to bull trout and to bull trout critical habitat. In addition, the Project will remove approximately 150,238 ft^2 (3.45 acres) of existing overwater cover, for a net decrease of overwater cover by 129,132 ft^2 (~3 acres). Though the overwater coverage generated by the proposed action will result in shading impacts to nearshore habitat in perpetuity, the net reduction in overwater coverage within the action area will be an improvement over existing conditions. As a result, the potential for these changes to measurably affect bull trout is considered insignificant. The Project-related overwater cover is anticipated to have insignificant effects on bull trout critical habitat, and the substantial net reduction of overwater cover within the action area may result in beneficial effects to habitat at the action area scale.

In addition, temporary shading will result from the use of barges during construction and from seasonal floats associated with the fishing pier. Shading associated with barges will be limited to a two week period for the removal of the existing ferry terminal, and for a seven month period during the removal of the Tank Farm Pier and construction of the new terminal. During the seven month period at the site of the new facility, the barges will be moved regularly to access different work areas. Due to the temporary nature of the effects associated with barges, no permanent effects to habitat are anticipated from barge-related shading. As a result, these effects to bull trout and to bull trout critical habitat are considered insignificant.

Benthic Habitat

Benthic areas provide habitat for forage fish that provide a food source for bull trout. Dredging and installation of piles will impact benthic habitat. The dredging footprint (48,000 ft^2) for the new ferry trestle will create deeper water habitat (from -14 to -30 MLLW) that receives less light than shallower habitats. However, this footprint is not located in forage fish spawning areas and will affect an area that is currently light limited (under the Tank Farm Pier). In addition, the starting and ending elevations for the dredge prism lie deeper than the water depths considered to be part of designated bull trout critical habitat.

In water, the Project will install 14 piles for construction of the new trestle; two casings for the transfer span; one casing for the overhead loading structure; 18 piles for the fixed dolphins; 18 piles for the wingwalls; 8 piles for the new terminal building; and 49 piles for the new fishing pier, resulting in a total of 445 ft^2 permanent loss of benthic habitat. This loss will degrade natural habitats within the Project footprint, by removing native substrate and the associated epibenthic and infaunal communities, and by permanently replacing natural forms of habitat structure with piles.

However, the Project will remove 290 piles associated with the existing terminal and fishing pier and 3,930 Tank Farm Pier piles, resulting in 3,315 ft^2 increase in benthic habitat. As a result, the Project will result in a 2,870 ft^2 net benthic habitat gain that will allow for the establishment of additional benthic macroalgae and macroinvertebrates throughout the action area and potential improvements in available forage fish spawning habitat.

We do not expect that permanent features of the Project will prevent or discourage migration through the area, or expose bull trout to heightened predation risk or other acute or chronic stressors. Furthermore, because of the small amount and low quality of affected foraging habitat, the overall gains in potential foraging habitat, and because productive, alternative foraging opportunities are readily available, we conclude that these adverse effects to habitat will not significantly disrupt normal bull trout behaviors. In summary, the anticipated effects to benthic habitat resulting from the Project may result in slight improvements of available habitat and habitat quality within the action area, but these changes are not expected to measurably affect bull trout, their prey base, or the key functions provided by bull trout critical habitat.

Elevated Underwater Sound

While constructing the terminal and associated pile structures (dolphins, wingwalls, etc.) and relocating the fishing pier, the Project will install approximately thirty-four 24-inch diameter concrete piles with an impact hammer below the MHHW. In addition, 73 permanent steel piles (12- to 36-inch diameter) and three casings (two 60-inch diameter and one 130-inch diameter) will be installed with a vibratory hammer below the MHHW. The Project will implement underwater sound and marbled murrelet monitoring plans.

As of June 2008, the USFWS, Federal Highway Administration, WSDOT, and other signatory agencies have endorsed application of new interim criteria for estimating onset of injury developed by the Fisheries Hydroacoustic Working Group (2008). These new interim criteria apply a SEL framework for assessing fish injury.

In 2004, the California Department of Transportation and Federal Highway Administration convened a group of experts in the field of underwater acoustics (referred to as the Fisheries Hydroacoustic Working Group) with the intent of evaluating and refining criteria. This effort included an extensive literature review as the basis for a report on the topic (Hastings and Popper 2005) and a white paper proposing interim criteria (Popper et al. 2006). The Hastings and Popper report (2005) suggested a metric of SEL may be more appropriate for assessing potential injury to fishes from impact pile driving; in part, because the use of SEL allows for the summing of energy over multiple pile driving pulses, which cannot be accomplished when using peak pressure.

The new interim criteria for fish injury identify a single-strike SPL of 206 dB_{peak} and 183 dB accumulated SEL for fish less than 2 grams. The interim criteria identify a single-strike SPL of 206 dB_{peak} and 187 dB accumulated SEL for fish greater than 2 grams (FHWG 2008).

We use the practical spreading model (Davidson 2004) to estimate the distance from piling installation operations (R; range) at which transmission loss (TL) can be expected to attenuate SPLs and SELs to below thresholds for injury and significant behavioral interference. The calculation [TL = 15*Log(R)] assumes that sound levels decrease at a rate of 4.5 dB per doubling distance. This method also assumes that single-strike SELs less than 150 dB do not accumulate to cause injury ("effective quiet") (Stadler, Pers Comm, 2009).

We used what we consider, for this Project, a "worst-case" set of assumptions when applying the practical spreading model. We used single-strike SPLs of 184 dB_{peak} and 170 dB_{rms}, a single-strike SEL of 159 dB, and assumed as many as 1,500 strikes/day during a single 10- or 12-hour workday. These assumptions regarding unattenuated pressures are within the range reported in the literature for similar operations (CALTRANS 2007). For the purposes of our analysis, we assumed that no attenuation would be achieved through the use of a sound attenuation system.

Based on the studies and findings presented here and in previous sub-sections, we expect that subadult and adult bull trout exposed to an accumulated SEL of 187 dB will be injured or killed. We also expect that subadult and adult bull trout, when exposed to single-strike SPLs of 150 dBrms or above, will or may experience a significant disruption of their normal behaviors (i.e.,

ability to successfully feed, move, and/or shelter). Pile driving with an impact hammer may cause bull trout to temporarily avoid the area, impede or discourage free movement through the area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.

The total energy content and sound wave forms that result from vibratory and impact pile driving are very different. Vibratory pile drivers impart less energy to the surrounding environment and produce a muted wave form. Where impact pile driving and proofing is concerned, the composition and size of the piling influences the sound wave form and total energy content. Smaller hollow steel pipe piles generally produce lower peak SPLs and impart less total energy than do larger hollow steel pipe piles. Wood, plastic, and concrete piles all typically produce lower peak SPLs and impart far less total energy than do comparatively-sized hollow steel pipe piles.

Applying the methods of analysis summarized here, impact driving of concrete piles may kill or injure subadult and adult bull trout to a distance of approximately 18 m (59 ft) from piling installation operations. Impact driving of concrete piles may also significantly disrupt normal bull trout behaviors to a distance of approximately 215 m (705 ft). However, the duration of impact pile driving will be limited in total duration to 25.5 hours of impact driving over nine days (45 minutes per pile, 34 piles), and limited in daily duration to 3.75 hours or less (5 piles per day) during months when the potential for bull trout presence in the Project vicinity is low.

With full implementation of the agreed upon conservation measures, and because of the small area of potential injury (18 m, 59 ft), and short duration of impact pile driving, we expect injury or death of bull trout related to elevated sound levels will be discountable. Similarly, because of the limited daily and total duration of impact pile driving activities, coupled with low documented numbers of bull trout during the months when pile driving will occur and the fact that those bull trout would likely be moving through the Project area rather than remaining there for extended periods, we expect that disruption of the normal behaviors of subadult and adult bull trout within 215 m (705 ft) of pile driving activities will be insignificant. The temporary underwater sound impacts will also not have lasting or measurable effects on the key functions provided by bull trout critical habitat, and are therefore considered insignificant. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore these activities will have no effect on bull trout rearing and spawning habitat or these essential behaviors.

Propwash Scour and Vessel Wake Wash

Modeling results for the proposed terminal location demonstrated a small and localized scour hole (approximately 1.4 ft deep) could develop at a depth of -20 to -25 MLLW, located 40 to 50 ft offshore from the MHHW shoreline (Coast and Harbor Engineering 2012b). Changes to benthic habitat at these depths, and of this size would have insignificant impacts to benthic habitat at the action area scale, and to bull trout and bull trout critical habitat.

The 2.2 ft deep scour hole at the existing ferry terminal, at a depth of -25 to -35 ft MLLW, will gradually fill in from longshore sediment transport processes when the terminal is removed. This will result in potential long-term restoration of benthic habitat at this location. Changes to benthic habitat at these depths, and of this size would have insignificant impacts to benthic habitat at the action area scale, and to bull trout and bull trout critical habitat.

Changing the location of the ferry will change the energy and direction of vessel wake wash relative to the shoreline. Modeling demonstrated that wake wash from the new ferry terminal will arrive at the shoreline with little energy (Coast and Harbor Engineering 2012b). Wave heights generated by ferries are not expected to exceed 0.6 ft (Coast and Harbor Engineering 2012b). Wave heights during yearly storms at this location range from 2 to 3 ft (Coast and Harbor Engineering 2012b). Effects associated with vessel wake wash to habitat or habitat processes, and to bull trout or bull trout critical habitat, will be insignificant.

Upland Construction of the Mukilteo Ferry Terminal and Associated Infrastructure

With implementation of the proposed conservation measures and permanent design elements, we conclude that upland elements, with the exception of stone column installation and stormwater treatment, and all associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat.

Upland construction will include placement of fifty steel H- or 12-inch diameter piles to form the foundation for the new two story terminal building, measuring 4,000 ft^2 on the first level and 12,500 ft^2 on the second. In addition, construction of the terminal will require eight 24-inch diameter concrete piles be driven in the intertidal zone. The effects associated with these eight piles, along with the 26 other concrete piles that will be driven in water as part of the Project, are addressed in the adverse effects section below. The Project will install the foundation piles with the use of both vibratory and impact pile hammers. Noise and vibration resulting from the work may extend into the immediately adjacent waters at levels detectable by fish. However, we do not expect that temporary sound will reach levels likely to cause significant behavioral disruption or physical injury. Any related temporary effects to normal bull trout behaviors (feeding, moving, and sheltering) will not be measurable and are therefore considered insignificant. These temporary impacts will not affect the key functions provided by bull trout critical habitat, and are therefore considered insignificant.

In an effort to minimize potential effects to culturally sensitive areas and to potentially contaminated soils and groundwater stemming from construction of the new facility, approximately 38,000 cy of fill will be placed on the site, ranging in depth from one to seven feet. Fill will be thoroughly compacted and held in place with retaining walls, reducing infiltration of surface water into soils on the site. Fill will be contoured to allow stormwater to drain to water quality treatment catch-basins or vaults placed underneath the pavement throughout the site. With full implementation of proposed BMPs, the placement of fill on the site is unlikely to generate any measurable impacts to bull trout, their prey species, or to nearshore FMO critical habitats.

New impervious surface and associated stormwater treatment is discussed in the adverse effects section below.

Adverse Effects of the Action (Bull Trout and Critical Habitat)

While we expect that several of the included Project elements, and many associated items of work, will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat, we do nevertheless expect that measurable, adverse effects will result from the Project. Construction of the new ferry terminal and fishing pier and demolition of the existing ferry terminal and fishing pier includes construction activities we expect will result in measurable, adverse effects to bull trout and their habitat. These activities include clamshell dredging, removal of wood pilings, installation of permanent steel and concrete piles, installation of stone columns, and increasing the PGIS acreage in the action area.

Construction activities conducted below MHHW will produce stressors with potential adverse effects to bull trout, their prey base, and habitat. These stressors include: temporary effects to water quality (turbidity, dissolved oxygen, and low-level contamination) resulting from dredge operations, installation of stone columns, and pile removal and installation activities; increased bioavailability of contaminants within the action area as a result of potential redistribution of contaminants in the action area resulting from bed disturbance and sediment transport; and permanent effects to water and habitat quality associated with stormwater releases into Possession Sound. These stressors have the potential to injure a limited number of subadult and adult bull trout. Temporary exposures may also significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). These exposures may temporarily cause bull trout to avoid the action area, may impede or discourage free movement through the action area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.

The sub-sections that follow discuss these Project elements and activities, resulting stressors, exposures, and adverse effects in greater detail.

<u>Temporary Exposure to Elevated Turbidity, Contaminants and Degraded Water Quality</u>

Construction of the Project includes activities we expect will temporarily degrade water quality and result in measurable, adverse effects to bull trout and their habitat. These activities include installation and removal of piles, installation of stone columns, and dredging.

A general description of the effects to fish associated with each anticipated water quality stressor (i.e. turbidity, reduced levels of dissolved oxygen, and contaminants) is provided below, followed by a characterization of the anticipated extent of these effects, and a discussion of anticipated exposure and biological response.

Turbidity

Although few studies have specifically examined the issue as it relates to bull trout, increases in suspended sediment affect salmonids in several recognizable ways. The effects of suspended sediment may be characterized as lethal, sublethal or behavioral (Bash et al. 2001; Newcombe and MacDonald 1991; Waters 1995).

Lethal effects include gill trauma (physical damage to the respiratory structures), severely reduced respiratory function and performance, and smothering and other effects that can reduce egg-to-fry survival (Bash et al. 2001). Sublethal effects include physiological stress reducing the ability of fish to perform vital functions (Cederholm and Reid 1987), increased metabolic oxygen demand and susceptibility to disease and other stressors (Bash et al. 2001), and reduced feeding efficiency (Bash et al. 2001; Berg and Northcote 1985; Waters 1995). Sublethal effects can act separately or cumulatively to reduce growth rates and increase fish mortality over time. Behavioral effects include avoidance, loss of territoriality, and related secondary effects to feeding rates and efficiency (Bash et al, 2001, p. 7). Fish may be forced to abandon preferred habitats and refugia, and may enter less favorable conditions and/or be exposed to additional hazards (including predators) when seeing to avoid elevated concentrations of suspended sediment.

Exposure concentration and duration will strongly influence whether temporary exposures cause lethal or sublethal effects. Information is limited and there are important sources of uncertainty. These sources of uncertainty include grain size, the quantity and composition of resuspended sediment, the quantity and composition of released interstitial pore water, and the rate or degree of contaminant desorption to the surrounding water column. Additional sources of uncertainty include the effect of intermittent, episodic, or transient exposures (Burton et al. 2000, p. ab; Marsalek et al. 1999, p. 34), variations in tolerance among exposed individuals, populations, and/or species (Ellis 2000, p. 89; Hodson 1988, p. ab; Lloyd 1987, p. 502), and, the potential for additive or synergistic effects among water quality stressors (Burton et al. 2000, p. ab; Ellis 2000, p. 88; Lloyd 1987, p. 494). Burton et al. (2000, p. ab) have emphasized the importance of "real-world" patterns of exposure. Lloyd (1987, pp. 492, 501) suggests that water quality stressors can exert a greater effect when dissolved oxygen levels are low. Hicks (1999 in WSDOT 2010a, p. H-18) reports avoidance behavior in salmonids responding to dissolved oxygen levels below 5.5 mg/L.

Estimate of the Extent of Effects – Turbidity

For the existing terminal, removal of 248 piles will occur for 73 hours over a period of two weeks during a third in-water work window (July 15 to February 15). For removal of the existing fishing pier, 42 piles will be removed over a two week period. For the Tank Farm Pier, pile removal activities will occur over a large area (3.17 acres), remove approximately 3,900 piles, and take ten months, split between two in-water work windows (September 1 to February 15). Impact pile installation for the trestle and bulkhead would extend over five days. The transfer span casings would take two days to install (vibratory) with total construction duration for the drilled shafts extending over two weeks. Installation (vibratory) of the overhead loading structure casing would take one day with total construction duration for the drilled shafts

extending over two weeks. Piles for wingwalls and fixed dolphins would be installed (vibratory) over six days. In-water piles for the new terminal building would be installed (impact) over a two day period. Piles for the new fishing pier would be installed (impact and vibratory) over a six day period.

Based on the Form and supporting modeling reports (Coast & Harbor Engineering, 2012a), during installation and removal of piles, increased turbidity surrounding the piles will be confined to within 150 ft of the piles. Potential for elevated turbidity during the entire in-water work window (up to seven months) in 2015-2016 will persist within 150 ft of the Tank Farm Pier, new trestle and bulkhead, and new passenger building. Potential for elevated turbidity for up to seven months of the in-water work window in 2016-2017 will persist within 150 ft of the Tank Farm Pier, pedestrian overhead loading structure, transfer span, wingwalls and inner dolphins. In the 2017-2018 window, elevated turbidity for 30 days will persist within 150 ft of the existing terminal, existing terminal pier and fishing pier.

Installation of stone columns also has the potential to increase turbidity. Stone columns will be constructed in 2015 in an area of 25,000 ft^2 during four weeks, over a two month period, during the in-water work window (July 15 to February 15). Modeling conducted for the Project indicates these effects would extend approximately 177 ft from the Project footprint. At this distance, turbidity would decrease to 5 NTU above background concentrations. During stone column installation (2015), elevated turbidity up to 177 ft from the columns will persist for 30 days over a two month period.

Sediments that are resuspended during dredging will settle out of the water column within approximately 150 ft of the dredge prism (Coast & Harbor Engineering, 2012a). During dredging, turbidity would decrease to 3 NTU above background within 150 ft and to background levels within approximately 300 ft. Dredging will occur over a 30 day period between November 1 2015 and February 15, 2016. As a result, an area of elevated turbidity will extend up to 150 ft from dredge prism during these months.

Extent of Exposure and Biological Response - Turbidity

Adult and subadult bull trout may occupy the waters immediately surrounding the existing and proposed ferry terminal and public fishing pier at any time of year. Data to estimate the number of bull trout that may forage, migrate, and overwinter in this portion of the action area are limited; however, recent telemetry studies (Goetz et al. 2012) documented the presence of winter migrants in the vicinity of the Project between November and January, and other data document bull trout presence in nearshore areas between April and August. As a result, given the substantial affected area and duration of anticipated in-water work, in particular the pile removal associated with the Tank Farm Pier, the potential of bull trout presence during in-water work elements of the Project cannot be discounted, nor can the potential exposure of individual bull trout to Project related turbidity impacts.

A number of site-specific conditions will influence the spatial extent of potential turbidity and water quality exposures. Acute exposures are usually most intense in the initial mixing zone where sediment resuspension creates a three-dimensional plume that dissipates vertically,

horizontally, and longitudinally (Bridges et al. 2008, pp. 6-8, 15, 18). The size and shape of the temporary plume, and therefore the spatial extent of potential exposures, will be influenced by the following: the quantity and composition of resuspended sediment, the quantity and composition of released interstitial pore water, the rate or degree of desorption to the surrounding water column, particle size and resettling rate, discharge volume, current, tidal flux, degree of turbulence, height of release to the water column, water temperature and salinity, and operational considerations (Bridges et al. 2008, pp. 5, 7-9, 13, 20, 42). Empirical evidence suggests that plumes resulting from dredging generally transition from "near field zone" processes (including potential acute exposures), to "far-field zone" processes within 100 m of the operation (Bridges et al. 2008, p.7).

To limit the extent of potential exposure associated with sediment disturbing activities to the dilution zones modeled for the Project, water quality sampling and chemical analyses will be conducted throughout the full duration of in-water activities. Turbidity monitoring samples will be collected twice a day from two locations: upgradient from the work area to evaluate background conditions and downgradient from the work area to evaluate impacts from work. Samples will be collected from the surface water, the middle of the water column, and from water two feet above the sediment surface at each location. Water column samples will be collected once daily for chemical analyses of PAHs, chlordanes and other COCs, if appropriate, based on the results of the dredge material characterization sampling. Water column samples will be submitted for chemical analyses using 48-hour turnaround time.

The contractor will be required to submit water quality monitoring results daily to WSF for review. The results will be provided to Ecology as specified in permit requirements for review, and annual reporting will also be provided to USFWS. It is possible that the frequency of water sampling/chemical analyses could be reduced if sampling indicates that water quality is not being affected by the activity.

Tidal current is bidirectional in the Project area but typically flows to the east at the site. The samples representing background conditions will be collected 200 ft upgradient from the work area. Upgradient background samples will be collected primarily to the west of the work area. The samples representing conditions resulting from construction activities (i.e. compliance samples) will be collected from locations that are 150 ft downgradient from the work area. The compliance samples will primarily be collected east of the work area.

Normally, project water quality monitoring changes to visual turbidity monitoring after several rounds of quantitative monitoring indicate continued compliance with the 401 Water Quality Certification criteria. Monitoring for the project will continue to be quantitative for both turbidity and chemical analyses unless the monitoring shows no effects and the change to visual monitoring is approved by Ecology.

Pile removal and installation will produce conditions of high turbidity that are most intense closest to the operations. Exposed individuals may suffer significant, sub-lethal physiological stress. We expect that acute water quality exposures with the potential to injure or kill subadult and adult bull trout will occur within 150 ft of pile removal activities.

In the vicinity of the Tank Farm Pier, elevated turbidity levels would persist during working hours for up to seven months over two in-water work windows. Given the long duration of in-water construction and pile removal activities at this location, individual fish could experience multiple exposure events during their migration through the Project area. Due to the rapid rate of observed bull trout migration and movement within the marine environment in the vicinity, we anticipate exposure events would be brief (less than one hour), and could, but would not necessarily, result in injury. Given the limited number of bull trout observed in the Project vicinity, direct exposures potentially resulting in physical effects, would be limited to a small number (1 to 2) of individual fish and could result in gill abrasion, leading to reduced respiratory function and performance.

Given the short-duration of pile-removal activities in the vicinity of the existing terminal and fishing pier and pile installation activities at the proposed terminal and fishing pier (73 hours over two weeks during a third in-water work window), coupled with the rapid rate of bull trout migration and movement documented within the marine environment in the Project vicinity, the potential for bull trout exposure to these stressors at these locations is insignificant.

Installation of stone columns also has the potential to increase turbidity. Stone columns (200 3-foot diameter columns) will be constructed over an area of 25,000 ft^2 over four weeks, during the in-water work window (July 15 to February 15). Modeling conducted for the Project indicates, worst case, these effects would be unlikely to extend beyond 177 ft from the stone columns. At this distance, turbidity would decrease to 5 NTU above background concentrations. However, to minimize potential impacts, water quality will be monitored during stone column installation to ensure elevated turbidity and water quality impacts do not extend beyond 150 ft.

Stone column installation will produce conditions of high turbidity that will be intense closest to the operations. We expect that installation of stone columns, will temporarily degrade water quality and thereby result in measurable, adverse effects to bull trout and their habitat within 177 ft from the columns for four weeks. Due to the shorter duration of these impacts and the fact that bull trout are well adapted to survive limited periods of elevated turbidity resulting from natural events, we conclude turbidity related effects to bull trout from stone column installation activities will be biologically insignificant.

Disturbance and temporary upwelling or plumes resulting from stone column installation could also potentially disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). Column installation may cause bull trout to temporarily avoid the area, may impede or discourage free movement through the area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions (i.e. elevated contaminant concentrations, which are addressed in the Contaminants section below).

Sediments that are resuspended during dredging will settle out of the water column within approximately 150 ft of the dredge prism (Coast & Harbor Engineering, 2012a). During dredging, turbidity would decrease to 3 NTU above background within 150 ft and to background levels within approximately 300 ft. Dredging will occur over a 30 day period anytime between November 1 and February 15. Water quality will be monitored during dredging to ensure turbidity does not extend beyond 150 ft.

Dredging operations will use an environmental clamshell bucket operating from barges, except where site conditions or obstructions require use of a conventional bucket. The Project will implement BMPs to minimize release of sediment to the surrounding waters, monitor for compliance with aquatic life turbidity criteria at the edge of the allowable mixing-zone (300 ft).

We do not expect that individuals will be injured or killed as a result of entrainment or direct physical contact with the dredge device. Injury or mortality resulting from direct contact with dredging equipment is extremely unlikely, and therefore discountable.

We expect that Project dredging, will temporarily elevate turbidity and thereby result in measurable, adverse effects to bull trout and their habitat within 150 ft of the dredge prism, over four weeks. Turbidity will be intense closest to the operations. Due to the shorter duration of these impacts and the fact that bull trout are well adapted to survive limited periods of elevated turbidity resulting from natural events, we conclude turbidity related effects to bull trout from dredging activities will be biologically insignificant.

Dissolved Oxygen

When suspended in the water column, dredged anaerobic sediments and woody debris can increase biological oxygen demand (Hicks et al. 1991 in WSDOT 2010a, p. H-18)(Morton 1976 in WSDOT 2010a, p. H-18). Phipps et al. (1992 in USACE 2006, p. 13) report temporary reductions in dissolved oxygen content, on the order of 1 to 2 mg/L below ambient, background concentrations. When released during the course of dredging, dredged sediments, woody debris, and pore water may also increase turbidity or introduce sediment contamination to the surrounding water column. Hicks (1999 in WSDOT 2010a, p. H-18) reports avoidance behavior in salmonids responding to dissolved oxygen levels below 5.5 mg/L.

Estimating the Extent of Effects – Dissolved Oxygen

The modeling completed to estimate turbidity and sedimentation impacts associated with dredging activities for the project has been used to estimate the extent of potential effects to dissolved oxygen. Dredging will occur over a 30 day period during December 2015 to January 2016. Sediments that are resuspended during dredging will settle out of the water column within approximately 150 ft of the dredge prism (Coast & Harbor Engineering, 2012a). Our worst-case assumption is that changes to dissolved oxygen would be confined to this same area during these months.

Extent of Exposure and Biological Response – Dissolved Oxygen

Given the presence of adult and sub-adult bull trout within the action area described above, there is potential for exposure to reduced dissolved oxygen levels within the area described above during dredging activities. If oxygen levels within the water column decline to levels below 5.5 mg/L, we expect that bull trout will avoid the area (Hicks 1999 in WSDOT 2010a, p. H-18). Due to the rapid rate of observed bull trout migration and movement within the marine environment in the vicinity, we anticipate exposure events would be brief (less than one hour), and could, but would not necessarily, result in injury. Given the limited number of bull trout

observed in the Project vicinity, their rapid rate of migration and movement through the marine environment, and the short and episodic duration of dredging activities (i.e. a total of 30 days spread over a two-month period), we conclude that dissolved oxygen related effects to bull trout from dredging activities will be biologically insignificant.

Contaminants

Recent sampling efforts beneath the Tank Farm Pier detected chlordane and other organochlorine pesticides at depths of 0 to 4 ft and 4 to 8 ft below ground surface with PAHs detected in the 8 to 12 ft below ground surface layer. Higher levels of contamination were detected in deeper water near the seaward end of the pier. Earlier sampling efforts throughout the action area detected contaminants in upland soils, groundwater, and nearshore sediments. Contaminants encountered in these earlier studies included petroleum hydrocarbons, benzene, toluene, ethylbenzene and xylenes, and concentrations were generally highest on the western portion of the property. As a result, in-water Project elements have the potential to result in low-level contamination via suspension or resuspension of contaminated sediments or release of contaminated ground or pore water into surrounding water and sediments.

Chlordane can be lethal to salmonids and can have lethal and sublethal effects to various aquatic species that salmonids eat (Eisler 1990). Total chlordane levels sampled within the action area were 19 ug/kg, exceeding the 2.8 ug/kg DMMP screening level standards. In a 2012 Sediment Sampling Data Report of the Project area (WSDOT 2012b), organochlorine pesticides were found in shallow (0 to 4 ft below ground level), mid-depth (4 to 8 ft), and deep (8 to 12 ft) samples. These types of pesticides have been potentially linked to the disruption of endocrine development and functioning. Petroleum hydrocarbons were also found at all the sampling depths. Petroleum hydrocarbons have been linked to a wide variety of effects including respiratory, circulatory, metabolic, immune, and reproductive changes in aquatic organisms.

Creosote contains numerous constituents that are known to be toxic to aquatic organisms (Eisler 1987; Germain et al. 1993; Brooks 1994; Brooks 2000; Johnson et al.2002). Creosote is composed primarily of PAHs (about 65 to 85 percent), with smaller percentages of phenolic compounds (ten percent), and nitrogen-, sulfur-, or oxygenated heterocyclics (Brooks 1994). Variations in physical and chemical characteristics of PAHs are generally related to molecular weight (Eisler 1987). With increased molecular weight, aqueous solubility decreases, solubility in fats increases, and resistance to oxidation and reduction decreases. Lower molecular weight (2-3 ring) PAHs are more mobile and can have significant acute toxicity to some organisms, whereas the higher molecular weight (4 to 7 ring) PAHs do not. However, all known PAH carcinogens, cocarcinogens, and tumor producers are in the high molecular weight PAH group.

Acute exposure to PAHs through the water or sediment can result in narcosis (Van Brummelen et al. 1998), suppressed immune function (Karrow et al. 1999), hormone disruption, and hepatic tumors in fishes (Kahn et al. 1986; Stein et al. 1990; Johnson et al.2002). PAHs are ubiquitous in the marine environment and primarily originate from combustion products and petroleum (Meador et.al. 1995, Burgess 2007). The toxic effects of PAHs to aquatic species depends on several factors, including route of exposure, duration and concentration of exposure, chemical

composition, organism sensitivity, life stage affected, organism potential for detoxification/excretion, and the physical condition of the particular organism during exposure (DNR 2008).

Studies have shown that high concentrations of toxic chemicals in sediments are adversely affecting Puget Sound biota via detritus-based food webs (Johnson et al. 2002). Meador et al. (1995) provided a thorough review of the literature on factors governing the bioaccumulation of PAHs in marine organisms (invertebrates and fish). The study concluded that the major routes of exposure for marine species were through the uptake of waterborne chemicals and through the diet. Direct uptake of sediment-bound chemicals (e.g., through ingestion or absorption through the integument of worms and fish) appears to be negligible. Because PAHs tend to adsorb to sediments when sediment is undisturbed, only a portion of parent PAH compounds are readily bioavailable to marine organisms.

Overall, the laboratory and field studies indicate that creosote-treated wood structures can leach PAHs and other toxic compounds into the environment (Poston 2001). Chemicals in creosote break down in water very slowly. They tend to cling to particles of matter, making sediments the primary location for these contaminants to collect in aquatic environments (DNR 2008). Accumulation of PAHs in sediment is relatively limited spatially (within approximately 30 ft of structures) and has not generally been associated with measured, significant, biological effects except in close proximity or direct adhesion to the structures (Stratus 2006).

However, when these sediments are disturbed, PAH compounds can potentially desorb into the water column and can be redeposited in surface sediments (Romberg 2005). Weston (2006) reported that during pulling of creosote pilings at the site of an old log yard operation, elevated PAH concentrations persisted for five minutes in the water column after the piles were pulled before returning to background levels. All measured water quality concentrations stayed below the Washington State standards of 300 parts per billion. Smith (2008) evaluated PAHs and phenols in sediments, timber, water and oyster tissue before and after removal of creosote treated posts. Smith determined that PAHs in surface sediments increased from 24.1 mg kg^{-1} dry weight to 45.5 mg kg^{-1} dry weight after post removal and to 59.7 mg kg^{-1} dry weight six months later. Smith also determined that the total PAHs (primarily low-molecular weight) dispersed to the environment when a creosote post was pulled out was at least 0.67 g.

Resident benthic organisms may be exposed to PAHs through their diet, through exposure to contaminated water in the benthic boundary layer, and through direct contact with the sediment (Johnson et al.2002). PAHs may bioaccumulate in aquatic invertebrates within these benthic communities (Varanasi et al. 1993; Meador et al. 1995). Bottom dwelling marine fish such as English sole, which feed on benthic invertebrate prey, could be exposed to high levels of PAHs. Most nonbenthic fish tissue contains relatively low concentrations of PAHs, and accumulation is usually short term because these organisms can rapidly metabolize and excrete them (DNR 2008, Lawrence and Weber 1984, West et al. 1984 as cited in Eisler 1987). Generally, vertebrates quickly metabolize some of the lighter PAH compounds (McElroy et al. 1991). Accordingly, once salmon enter free swimming life stages in freshwater when they are not closely associated

with bottom sediments or enter an open-water marine life stage, the potential to be exposed to contaminants from treated wood at levels that could adversely affect them is very low (Poston 2001).

Estimate of the Extent of Effect – Contaminants

The modeling completed to estimate turbidity and sedimentation impacts associated with pile driving, stone column installation, and dredging activities has been used to estimate the extent of potential short-term contaminant exposures resulting from resuspension and redistribution of contaminants and contaminated sediment in the action area.

Recent sampling efforts beneath the Tank Farm Pier detected chlordane and other organochlorine pesticides at depths of 0 to 4 ft and 4 to 8 ft below ground surface with PAHs detected in the 8 to 12 ft below ground surface layer. Higher levels of contamination were detected in deeper water near the seaward end of the pier. Accumulation of PAHs in sediment is relatively limited spatially (within approximately 30 ft of the structure) (Stratus 2006). Based on the Form and supporting modeling reports (Coast & Harbor Engineering, 2012a), during vibratory installation and removal of piles, increased turbidity and/or resuspended contaminants surrounding the piles will be confined to within 150 ft of the piles for a duration of up to seven months over three in-water work windows. Resuspension of PAHs will likely be confined to a much smaller radius around the pile, based upon a recent study (Weston Solutions and Pascoe Environmental Consulting 2006).

Samples collected beneath the pier in 2012 indicated that the upper four feet of material consists of sand trapped by the piles, forming a mounded layer or "cap" beneath the pier. Ideally sediment and creosote may be scraped off as the piles are pulled through the sand cap, reducing the potential for turbidity impacts and creosote release. The cap material in the upper four feet of the site is the material most susceptible to disturbance during pile removal. This sand is generally 'clean" with respect to contamination and would not adversely impact the areas adjacent to the pier. The sand cap likely reduces the potential for dispersion of deeper sediments that may have been affected by historic site activities.

Installation of stone columns also has the potential to resuspend or spread contaminated material. Stone columns (200 3-foot diameter columns) will be constructed over an area of 25,000 ft^2 over four weeks, during the in-water work window (July 15 to February 15). Pressure created by stone column installation could force contaminated soil or groundwater through the ground and into nearshore areas. Modeling conducted for the Project indicates, worst case, these effects would be unlikely to extend beyond 177 ft from the stone columns. At this distance, turbidity (and it is assumed, suspended contaminants) would decrease to 5 NTU above background concentrations. However, to minimize potential impacts, water quality will be monitored during stone column installation to ensure elevated turbidity, contaminants, and water quality impacts do not extend beyond 150 ft.

Sediments that are resuspended during dredging will settle out of the water column within approximately 150 ft of the dredge prism (Coast & Harbor Engineering, 2012a). During dredging, turbidity would decrease to 3 NTU above background within 150 ft and to background

levels within approximately 300 ft. Dredging will occur over a 30 day period during December 2015 to January 2016. Water quality will be monitored during dredging to ensure turbidity and associated contaminants do not extend beyond 150 ft. At completion of the dredge operation, the Project will perform sample analyses to confirm that surficial sediments meet sediment quality standards.

Dredge spoils will be disposed of offshore in compliance with DMMP standards at the Port Gardner site in Possession Sound. Authorized use of the DMMP Port Gardner open-water disposal site(s) is subject to independent section 7 consultation (USFWS Reference Number 13410-2010-I-0542; *Puget Sound Dredge Disposal Analysis Program*). Though this site is included in the action area, the effects associated with offshore disposal at this site are not addressed in this document because they were addressed in this prior consultation.

Any dredge spoils that do not meet DMMP criteria will be disposed of at existing commercial upland facilities permitted to accept contaminated waste. Recent sampling efforts beneath the Tank Farm Pier detected chlordane and other organochlorine pesticides at depths of 0 to 4 ft and 4 to 8 ft below ground surface with PAHs detected in the 8 to 12 ft below ground surface layer. Higher levels of contamination were detected in deeper water near the seaward end of the pier, outside the proposed dredge prism. Samples within the proposed dredge prism did not exceed DMMP screening level criteria.

Extent of Exposure and Biological Response - Contaminants

Given the presence of bull trout in the action areas, the industrial history of the Project site, and the physical and temporal extent of turbidity and sediment effects described above, bull trout in the action area could potentially be exposed to elevated levels of contaminants and/or contaminated sediments as a result of Project activities. However, given the limited understanding of sediment quality (in particular PAHs) within the areas defined above, the generally low concentrations of contaminants that have been documented within the action area, and the fact that toxic effects of PAHs and other contaminants to aquatic species depends on several factors, including route of exposure, duration and concentration of exposure, chemical composition, organism sensitivity, life stage affected, organism potential for detoxification/ excretion, and the physical condition of the particular organism during exposure (DNR 2008), it is not feasible to accurately predict the direct or indirect effects to individual bull trout resulting from suspended or resuspended contaminants from Project activities.

The areas defined above, represent the extent of short-term contaminant exposure resulting from Project activities. Given the types of pesticides identified at the Project site, Project activities within these areas could potentially result in the disruption of endocrine development and functioning in adult or sub-adult bull trout. Due to the rapid rate of observed bull trout migration and movement within the marine environment in the vicinity, we anticipate exposure events would be brief (less than one hour), and could, but would not necessarily, result in injury. Given the limited number of bull trout observed in the Project vicinity, direct exposures potentially resulting in physical effects, would be limited to a small number (1 to 2) of individual fish.

Given the number of creosote treated piles that will be removed, exposure to petroleum hydrocarbons within these areas could also result in a wide variety of effects including respiratory, circulatory, metabolic, immune, and reproductive changes in adult or sub-adult bull trout. PAH exposures with the potential to kill or injure bull trout via direct ingestion from the water column are considered discountable because most vertebrates and nonbenthic fish species quickly metabolize and excrete the lighter PAH compounds. Short-term exposures to contaminants and PAHs via the food chain would be localized (within 150 ft of piles and dredge prism, 177 ft of stone columns) and would gradually decrease as PAHs adsorbed to bottom sediments and were no longer bioavailable. However, due to the persistence of these contaminants in water, long-term indirect exposure via food web dynamics could result. Longer term PAHs exposures via food chain dynamics are discussed in the Indirect Effects section below.

Temporary increases in contaminant concentrations could also potentially disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). Elevated contaminant concentrations (associated with pile installation and removal, dredging, and stone columns intstallation) or contaminated plumes (associated with stone column installation) may cause bull trout to temporarily avoid the area, may impede or discourage free movement through the area, prevent individuals from exploiting preferred habitats. Elevated contaminant concentrations may also expose individuals to less favorable conditions (contaminated food-chain).

In summary, exposure to elevated turbidity over periods of weeks or months within 150 ft of the Tank Farm Pier could physically injure a small number of bull trout (1 to 2 fish) as a result of gill abrasion or respiratory injury. Although the potential for these physical effects to occur is low due to the limited number of bull trout in the Project area, limited prey resources, and the rapid documented movement of migrating bull trout through the marine environment in the Project vicinity, it cannot be discounted.

Direct and indirect exposure to elevated concentrations of contaminants over periods of weeks or months within 150 ft of the Tank Farm Pier and dredge prism, and within 177 ft of the of the stone columns could physically injure a small number of bull trout (1 to 2 fish) because of disruption of endocrine development and functioning. Although the potential for these physical effects to occur is low due to the limited number of bull trout in the Project area, limited prey resources, and the rapid documented movement of migrating bull trout through the marine environment in the Project vicinity, it cannot be discounted.

Exposure to contaminants via plumes, or effects to water and sediment quality over periods of weeks and months, is expected to disrupt normal bull trout behaviors and/or expose individuals to less favorable conditions (contaminated food chain). With full implementation of the agreed upon conservation measures, we expect that temporary, degraded water quality conditions will significantly disrupt the normal behaviors of subadult and adult bull trout within the distances described above, over seven months in 2015-2016, five months in 2016-2017, and during July and August in 2017-2018.

Degraded water quality conditions over these extended periods of time could potentially affect migration (PCE #2). Similarly, Project construction will temporarily degrade PCE # 8 (water quality and quantity) within these areas over the same period of time. However, the extent of these impacts will not measurably affect the key functions of bull trout critical habitat within the action area or larger scales. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore pile installation and removal, stone column installation, and dredging will have no effect on bull trout rearing and spawning habitat or these essential behaviors.

Indirect Effects (Bull Trout and Critical Habitat)

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action (USFWS and NMFS 1998).

Potential indirect effects include those resulting from stormwater discharges (discussed in insignificant and discountable effects section) and redistribution of contaminated sediments discussed below.

Stormwater Discharges

Stormwater generated by roadways contains pollutants detrimental to aquatic life. The primary constituents of concern are total suspended solids (TSS), total copper (TCu), dissolved copper (DCu), total zinc (TZn), and dissolved zinc (DZn). The USFWS and NMFS (Services) have established a freshwater behavioral threshold level for fish of 2µg/L above the background concentration for DCu and 5.6 µg/L above the background concentration for DZn (WSDOT 2012). However, standards for effects to salmonids have not yet been established for saltwater, so the freshwater standards were used for this analysis.

Metals

There are three known physiological pathways by which salmonids may uptake metals: 1) uptake of ionic metals at the gill surfaces (Niyogi et al. 2004), 2) dietary uptake, and 3) olfaction (sense of smell) involving receptor neurons (Baldwin et al. 2003). Of these three pathways, the mechanism of dietary uptake is least understood. For dissolved metals, the most direct pathway is through the gill surfaces.

Measurements of total recoverable metal concentration include a fraction that is bound to suspended solids and/or complexed with organic matter or other ligands; this fraction is not available to bind to gill receptor sites. As such, most metal toxicity studies have examined the dissolved metal fraction which is more bioavailable and therefore of greater significance for acute exposure and toxicity.

The relative toxicity of a metal can be altered by hardness, water temperature, pH, organic content, phosphate concentration, suspended solid concentration, the presence of other metals or contaminants (i.e., synergistic effects), and other factors. Eisler (1998) and Playle (2004) found

that dissolved metal mixtures exhibit greater than additive toxicity. Water hardness affects the bio-available fraction of metals; as hardness increases, metals become less bio-available for uptake at the gill surfaces and therefore less toxic (Hansen et al. 2002; Niyogi et al. 2004).

Copper

Even at low concentrations, copper is acutely toxic to fish. Effects of exposure to copper include 1) weakened immune function and impaired disease resistance, 2) impaired respiration, 3) disruptions to osmoregulation, 4) impaired function of olfactory organs and brain, 5) altered blood chemistry, 6) altered enzyme activity and function, and 7) pathology of the kidneys, liver, and gills (Eisler 1998).

The acute lethality of copper has been evaluated for bull trout. Hansen et al. (2002) examined acute toxicity and determined that rainbow trout (*Oncorhynchus mykiss*) fry and bull trout fry have similar sensitivities. The authors describe a 96-hour and 120-hour LC50 for bull trout under test conditions (100 mg/L hardness and 8 ºC), approximately 66.6 and 50.0 µg/L, respectively.

Baldwin et al. (2003) found that short pulses of dissolved copper, at concentrations as low as 2 µg/L, reduced olfactory sensory responsiveness by approximately 10 percent within 10 minutes, and by 25 percent within 30 minutes. At 10 µg/L responsiveness was reduced by 67 percent within 30 minutes. Baldwin et al. (2003) identified a copper concentration neurotoxic threshold of an increase of 2.3 to 3.0 µg/L, when background levels are 3.0 µg/L or less. When exceeded, this threshold is associated with olfactory inhibition. The authors also reference three other studies examining long-duration copper exposures (i.e., exceeding 4 hours); these studies found that long-duration exposures resulted in cell (olfactory receptor neuron) death in rainbow trout and Atlantic and Chinook salmon. Baldwin et al. (2003) found that water hardness did not influence the toxicity of copper to coho salmon sensory neurons.

More recently, Sandahl et al. (2007) documented sensory physiological impairment and related disruption to predator avoidance behaviors, in juvenile coho at concentrations as low as 2 µg/L dissolved copper.

The effects of short-term copper exposure may persist for hours and possibly longer. Although salmonids may actively avoid surface waters containing an excess of dissolved copper, exposed individuals may experience olfactory function inhibition. Avoidance of a chemical plume may cause fish to leave refugia or preferred habitats in favor of less suitable or less productive habitats. This, in turn, can make fish more vulnerable to predation and can impair foraging success, feeding efficiency, and thereby growth.

Folmar (1976) observed avoidance responses in rainbow trout fry when exposed to a Lowest Observed Effect Concentration of 0.1 µg/L dissolved copper (hardness of 90 mg/L). The EPA (1980a) also documented fry avoidance of dissolved copper concentrations as low as 0.1 µg/L during a 1 hour exposure, as well as a LC10 for smolts exposed to 7.0 µg/L for 200 hours, and a LC10 for juveniles exposed to 9.0 µg/L for 200 hours.

Zinc

Zinc occurs naturally in the environment and is an essential trace element for most organisms. However, in sufficient concentrations and when bioavailable for uptake by aquatic organisms, excess zinc is toxic. Toxicity in the aquatic environment and for exposed aquatic organisms is influenced by water hardness, pH, organic matter content, levels of dissolved oxygen, phosphate, and suspended solids, the presence of mixtures (i.e., synergistic effects), trophic level, and exposure frequency and duration (Eisler 1993). Bioavailability of zinc increases under conditions of high dissolved oxygen, low salinity, low pH, and/or high levels of inorganic oxides and humic substances. Most of the zinc introduced into aquatic environments is eventually partitioned into sediments (Eisler 1993).

Effects of zinc exposure include 1) weakened immune function and impaired disease resistance (Ghanmi et al. 1989), 2) impaired respiration, including potentially lethal destruction of gill epithelium (Eisler 1993), 3) altered blood and serum chemistry, and enzyme activity and function (Hilmy et al. 1987a; Hilmy et al. 1987b), 4) interference with gall bladder and gill metabolism (Eisler 1993), 5) hyperglycemia, and 6) jaw and branchial abnormalities (Eisler1993).

Hansen et al. (2002) determined 120-day lethal concentrations of zinc for test subjects that included bull trout and rainbow trout fry. Multiple pairs of tests were performed with a nominal pH of 7.5, hardness of 30 mg/L, and at a temperature of 8 °C. Bull trout LC50 values measured under these conditions ranged from 35.6 to 80.0 µg/L, with an average of 56.1 µg/L. Hansen et al. (2002) found that rainbow trout fry are more sensitive to zinc (i.e., exhibit a lower LC50) than are bull trout fry. The authors also report that older, more active juvenile bull trout are more sensitive than younger, more docile juvenile bull trout based on observed changes in behavior at the juvenile life stage. The authors argue that the timing of zinc and cadmium exposure and the activity level of the exposed fish are germane to predicting toxicity in the field.

The mode of action for zinc toxicity relates to net loss of calcium. Studies suggest that zinc exposure inhibits calcium uptake, although it appears this effect is reversible once fish return to clean water. The apparent difference in sensitivity between rainbow trout and bull trout may be due to the lesser susceptibility of bull trout to calcium loss. Hansen et al. (2002) state that differences in sensitivity between these two salmonids may reflect different physiological strategies for regulating calcium uptake. These strategies may include gills that differ structurally, differences in the mechanisms for calcium uptake, and/or variation in resistance to or tolerance for calcium loss.

There are no known studies or data describing adult bull trout response to lethal or near-lethal concentrations of zinc. Active feeding and increased metabolic activity are apparently related to sensitivity. It is unknown whether sensitivity to zinc varies between adult, subadult, and juvenile bull trout. Activity level may be a better predictor of sensitivity than age.

In addition to the physiological effects of zinc exposure, studies have also documented a variety of behavioral responses. Among these, Eisler (1993) includes altered avoidance behavior, decreased swimming ability, and hyperactivity. The author also suggests zinc exposure has implications for growth, reproduction, and survival.

Sublethal endpoints have been evaluated with test subjects that include both juvenile and adult rainbow trout (Eisler 1993; USEPA 1980b; USEPA 1987). Some of these test results clearly indicate that juvenile rainbow trout are more sensitive than adult rainbow trout. Using juvenile rainbow trout as test subjects, studies have found that sublethal effects occur at concentrations approximately 75 percent lower (5.6 µg/L) than the concentrations that result in lethal effects (24 µg/L) (Eisler 1993; Hansen et al. 2002). Sprague (1968) found that at concentrations as low as 5.6 µg/L juvenile rainbow trout exhibit avoidance behavior. Avoidance of a chemical plume may cause fish to leave refugia or preferred habitats in favor of less suitable or less productive habitats. This can make fish more vulnerable to predation and can impair foraging success, feeding efficiency, and thereby growth.

Estimate of the Extent of Effect

Existing impervious surface associated with the existing terminal totals two acres. Approximately one acre of runoff from the holding lanes receives basic treatment from a detention pond; runoff from the remaining PGIS discharges untreated directly into Possession Sound. Stormwater runoff from existing holding lanes generates approximately 477 lb/yr of TSS, 0.14 lb/yr of TCu, 0.048 lb/yr of DCu, 0.813 lb/yr of TZn, and 0.308 lb/yr of D Zn. No analysis of constituent concentrations or dilution zone was provided by the project proponent. The Project will provide no additional treatment of PGIS associated with the existing ferry terminal. As a result, the rate of annual loading and extent of water quality impacts in this portion of the action area will persist until redevelopment of the site alters the configuration of impervious surface in this area or changes the stormwater treatment provided for runoff generated by impervious surface in this area.

Existing impervious surface in the portion of the Project area on the Tank Farm site totals 41.26 acres, only 2.43 acres of which is PGIS. The Project will create an additional 10.2 acres of PGIS, mostly by converting the impervious surface of the Tank Farm property to roadway and holding areas. PGIS will discharge via the existing 24-inch and 30-inch diameter outfalls as well as one new outfall that will be constructed on the eastern edge of the Project. The new stormwater pipe will be located within the clean fill material placed on the site. The existing 8-inch pipes will be abandoned in place. All new PGIS will be treated using enhanced treatment (Filterra systems). No detention will be provided since stormwater discharges to Possession Sound are exempt from flow control requirements.

WSF will sweep the holding areas on a quarterly basis with a vacuum sweeper, which will reduce pollutants entering stormwater treatment BMPs. The level of reduction this vacuuming will generate is difficult to quantify but will positively contribute to a source reduction of potential stormwater runoff pollutants.

Pollutant loads and concentrations for the Project at the Tank Farm site were analyzed using the HI-RUN program approved by WSDOT and the Services per the 2009 Memorandum of Agreement. Cormix Version 6.0GT was used as the dilution modeling program for analyzing DZn and DCu dilution plumes. Dilution plumes were modeled using the median DCu and DZN concentrations produced by the HI-RUN model, as no water quality data is currently available from existing outfalls.

Except for total suspended solids (TSS), the Project's additional PGIS will increase overall pollutant loads as summarized in the following table:

Outfall	**Scenario**	**Pollutant Load (lb/yr)**				
		TSS	**TCu**	**DCu**	**TZn**	**DZn**
#4-24	Existing	1,540	0.192	0.044	1.16	0.33
	Proposed	253	0.095	0.059	0.45	0.30
	Difference	-1287	-0.097	+0.015	-0.710	-0.030
	Percent change	-83.6%	-50.5%	+34.1%	-61.2%	-9.1%
#5-30	Existing	215	0.055	0.013	0.333	0.094
	Proposed	168	0.15	0.089	0.69	0.46
	Difference	-47	+0.095	+0.076	+0.357	+0.366
	Percent change	-21.9%	+172.7%	+584.6%	+107.2%	+389.4%
#6-XX	Existing	0	0	0	0	0
	Proposed	97	0.084	0.051	0.04	0.27
	Difference	+97	+0.084	+0.051	+0.04	+0.27
	Percent change	NA	NA	NA	NA	NA

Dilution modeling estimates the distance at which pollutants of concern (specifically DCu and DZn) in stormwater runoff reach the thresholds established by the Services for potential water quality effects to salmonids (there are no thresholds for saltwater, so the analysis used the freshwater thresholds of 2 µg/L above the background concentration for DCu and 5.6 µg/L above the background concentration for DZn). There are no data on ambient DCu and DZn concentrations for Possession Sound but they are likely similar to those measured for Elliott Bay: 0.07 µg/L for DCu and 4.1 µg/L for DZn (Curl et al. 1988).

Results of the dilution modeling are summarized in the table below:

Outfall	Pollutant	Pre-Project	Post-Project
#4-24	DCu	12.9	12.9
	DZn	20.0	21.0
#5-30	DCu	19.1	19.1
	DZn	43.6	46.2
#6-XX	DCu	0	4.71
	DZn	0	15.5

For outfall #4-24, the distance at which DCu in stormwater discharge will dilute to 2ug/L above the background concentration is 12.9 ft, which is the same as the estimated distance for pre-Project conditions. DZn will be diluted to 5.6 ug/L above background concentrations within 21 ft of the outfall, which is a slight (1 foot) increase above estimated existing conditions. For outfall #5-30, the dilution distance is 19.1 for DCu (same as existing) and 46.2 for DZn (2.6 ft increase over existing), and it is 4.71 ft and 15.5 ft for the new outfall #6-XX. Fish utilizing the nearshore could therefore be exposed to a larger area of stormwater pollutants post-project.

With consideration for the low numbers of adult and subadult bull trout potentially foraging or migrating in the immediate vicinity of the outfalls, the limited extent of affected habitat (i.e., the immediate vicinity of the points of discharge), and the frequency, duration, and intensity of potential exposures, we expect that stormwater discharges will have no measurable effect on bull trout individuals, or their prey base, and are therefore insignificant.

However, the increased impervious surface resulting from the Project, and the lack of additional treatment for impervious surface at the existing terminal site, will result in increased annual loadings of stormwater constituents and increased stormwater releases associated with the Project discharging these constituents into Possession Sound in perpetuity. As a result, baseline conditions will be maintained in the vicinity of the existing ferry terminal. Bull trout critical habitat adjacent to the Project will be adversely affected in the immediate vicinity of the outfalls (up to 50 ft from the discharge points) because the Project will result in incremental degradation of environmental baseline conditions and PCE # 8 (sufficient water quality and quantity) in perpetuity within these small areas. Given the potential for fish to avoid areas affected by elevated concentrations of stormwater constituents, Project related stormwater releases also slightly degrade PCE #2 (migration habitats) in the immediate vicinity of the outfalls. However, the scale of these Project-related impacts will not measurably degrade or diminish the key functions provided by bull trout marine FMO habitat at the action area or larger scales, and therefore the Project will not adversely modify bull trout critical habitat.

Sediment Transport and Bioavailability of Contaminants

The tightly spaced pilings that support the Tank Farm Pier reduce wave energy. Removal of the pier has the potential to affect longshore sediment transport and the distribution of contaminants bound to these sediments, by increasing wave energy, particularly during storms from the west

and northwest. The sediment mound under the pier ranges in height from -11 ft MLLW to -19 ft MLLW. Wave energy at this location could mobilize sediments shallower than -15 ft MLLW. Sediments at greater depth would remain unaffected. Any erosion as a result of the pier removal would be slow unless an extreme storm event occurs. As a result, only the top few feet of the sediment mound would be potentially affected. Based upon sediment sampling in the Project area, these potentially mobilized sediments could be contaminated.

Disturbing the sediment mound under the pier via dredging and pile removal will destabilize and mobilize these sediments, making the contaminants that are contained within them bioavailable. The effects of these various contaminants are described in preceding subsections.

Estimate of the Extent of Effect

How sediment transport processes might uncover or resuspend existing contamination or redistribute contaminated sediment in the action area is not well understood. This Opinion uses the sediment transport modeling that was completed by the Project proponent as a surrogate predictor or estimate of the potential spread of contaminated sediments throughout the action area. In a 25 year storm event, sediments less than 2 mm (very coarse sand) may be eroded from the mound beneath the Tank Farm Pier, leaving behind an armor layer of larger sediments (coarse sand and gravel) along the surface of the remaining mound (Coast and Harbor Engineering 2012b). This model predicted that worst case (25-year storm event occurring immediately after construction before surface sediments have stabilized), an estimated 1,050 cy of material could be eroded. About half of these fine sediments would settle out into a deepwater depression immediately east of the pier with the remaining mobilized material moving beyond the depression to deposit down-current up to 1,800 ft from the pier. If 1,050 cy of material were to deposit within 1,800 ft of the pier, it would form a sediment layer 0.08 inch thick.

Given the limited information characterizing levels of contaminants under the Tank Farm Pier and the number of variables that could affect the resuspension and redistribution of contaminants in the action area, it is difficult to accurately predict the concentrations and extent of contamination resulting from the Project. Based upon previous studies of creosote pile removal, it can be assumed that subsurface creosote has likely leached into bottom sediments and persisted in a relatively undiluted and undisturbed state below the ground surface. When piles are removed, this preserved creosote could be pulled up to the surface and into the water column on the surface of piles and in plumes of resuspended sediment. The turbidity modeling described in the Direct Effects section effectively defines the extent of short-term water quality impacts. Because, PAHs tend to adsorb to bottom sediments, they could be redistributed, along with other sediments, in the vicinity of the Project. We assume that the sediment modeling summarized above, provides a reasonable estimate of the extent of potential long-term contaminant (PAH) redistribution.

Based on the model, longer term (six or more months) exposures to contaminants and PAHs via the food chain could extend over a 1,800 to 2,000 foot area as a result of sediment transport. Bioaccumulation of contaminants and PAHs could result in sublethal effects to individual bull trout including disruption of endocrine development and functioning, respiratory, circulatory, metabolic, immune, and reproductive changes. With full implementation of the agreed upon

conservation measures, we expect that temporary degradation of the food chain within 2,000 ft of the Tank Farm Pier, as a result of making contaminants bioavailable and redistributing contaminants via sediment transport, could persist for six to twelve months, post-construction, after which it is expected contaminants, PAHs in particular, would adsorb to bottom sediments and/or gradually be diluted or covered over by other sediments making them less bioavailable.

Mobilization of potentially contaminated sediments due to removal of the pier is anticipated to have insignificant direct effects on bull trout, because most non-benthic fish can rapidly metabolize and excrete potentially mobilized PAHs (DNR 2008, Lawrence and Weber 1984, West et al. 1984 as cited in Eisler 1987). Insignificant indirect effects on bull trout are also anticipated because significant concentrations of prey resources are not present within the potentially affected area and the effects to forage fish (described below) will be limited.

The prey species upon which bull trout rely, in particular forage fish, could be affected by contaminants made bioavailable by sediment redistribution. Documented forage fish spawning habitat lies largely outside the 1,800 ft drift cell through which these sediments could extend, except in the immediate vicinity of the Mt. Baker terminal, where historically, forage fish spawned. In recent years, after a habitat enhancement project was completed at the Mt. Baker terminal, forage fish have not been observed spawning at this location. Given the current distribution of forage fish and suitable forage fish spawning habitat in the action area, which lies outside this potentially affected drift cell, potential impacts to the bull trout prey base arising from the potential redistribution of contaminated sediment will be insignificant. In addition, the potential for direct or indirect exposure to contaminants will likely subside over time as sediments stabilize throughout the action area.

Because contaminated sediments could redistribute throughout a 1,800 ft long drift cell along the shoreline north of the proposed ferry terminal, benthic communities within designated bull trout critical habitat will be adversely affected as a result of incremental degradation of baseline conditions. The introduction of bioavailable contaminants within this area could result in impacts to benthic organisms or bioaccumulation within food webs that are reliant on benthic micro- and macroinvertebrates. However, key functions of critical habitat would not be adversely modified at the action area scale or in Possession Sound for the following reasons: suitable forage fish spawning habitat generally lies outside the potentially affected drift cell, a limited portion of the sediment mound under the pier could be mobilized over time, the area affected by changes in sediment transport is limited to a 1,800 ft drift cell (worst case), the amount of material that could be mobilized under normal conditions will be very small, and will be gradually reduced over time. Even if an extreme storm event occurs, the resultant layer of deposited material will not measurably affect the rate or distribution of vegetative growth or benthic populations within the sediment transport cell. Because of the limited use of the potentially affected drift cell area by forage fish for spawning, Project impacts would be unlikely to result in measurable impacts to the distribution and abundance of bull trout forage fish prey resources PCE # 3.

Effects of Interrelated & Interdependent Actions (Bull Trout and Critical Habitat)

Interrelated actions are defined as actions "that are part of a larger action and depend on the larger action for their justification"; interdependent actions are defined as actions "that have no independent utility apart from the action under consideration" (50 CFR section 402.02).

The transfer of ownership (from USAF to the Port of Everett) of the property where the Project will be constructed will occur in the spring of 2013, thus enabling the Project to move forward. The USAF determined the effects of this land transfer had no significant impacts on listed species. The USFWS is not obligated to consult on no effect determinations; therefore this determination rests with the action agency.

Summary of Effects of the Action (Bull Trout)

Based on location, extent of impacts and proximity to bull trout core areas and local populations, it is reasonable to conclude that a few individuals will be exposed to the action's short or long term effects. However, we are unable to quantify a specific number of individuals with any accuracy. Instead, we use a habitat surrogate to describe the extent of Project related effects to bull trout and bull trout critical habitat. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the Project will have no effect on bull trout rearing or spawning habitat, or these essential behaviors.

While we cannot entirely discount the risk of physical effects (i.e. gill abrasion and reduced respiratory function as a result of temporary exposures to elevated turbidity or reduced endocrine function and development as a result of exposures to elevated concentrations of contaminants), we expect that the number of killed or injured bull trout will be very low (i.e., a few individuals at most). These subadult and adult bull trout may originate from the Skagit, Stillaguamish or Snohomish/Skykomish bull trout core areas. Given the small number of bull trout affected, we expect that no measurable effect to numbers (abundance) will be evident at the scale of any local population or core area.

Temporary exposures resulting in sublethal physiological stress, and/or a significant disruption of normal behaviors in various forms could potentially have consequences for individual growth or long term survival: avoiding the Project area could prevent individual bull trout from exploiting preferred habitats and reduce foraging efficiency; impeding or discouraging free movement through the area could slow or delay migration; and/or exposing individuals to less favorable conditions like contaminated food chains, elevated turbidity or elevated contaminant concentrations could result in decreased respiratory or endocrine function. However, we expect that for most exposed bull trout these potential incremental effects to growth and long term survival will not be measurable. These subadult and adult bull trout may originate from any of eight bull trout local populations (Canyon Creek, N. Fork Stillaguamish River S. Fork Stillaguamish River, Upper Deer Creek, N. Fork Skykomish River, Salmon Creek, S. Fork Skykomish River, and Troublesome Creek local populations), and we expect that no measurable effect to numbers (abundance) or reproduction (productivity) will be evident at the scale of the local populations or core areas.

Though the Project will install two pier structures in Possession Sound, it will reduce the size and number of permanent impediments of the migratory corridor within the action area. Any measurable effects to migratory habitat (or migrating individuals) will be temporary, and we expect that no measurable short or long term effects to distribution will be evident at the scale of the local populations or core areas.

Summary of Effects of the Action (Critical Habitat)

Construction activities conducted below MHHW will produce stressors with potential temporary adverse effects to bull trout critical habitat. These stressors include: temporary adverse effects to water quality (turbidity, reduced dissolved oxygen levels, low-level contamination, increased metals loading or concentrations) resulting from dredge operations, installation of stone columns, pile removal and installation activities, sediment transport and stormwater releases. As discussed above, these exposures may temporarily cause bull trout to avoid the these areas, may impede or discourage free movement through the action area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions. As a result, foraging, migration and overwintering functions provided by the designated critical habitat in the Project area could be temporarily degraded, inhibited, or obstructed as a result of these stressors.

Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the Project will have no effect on bull trout rearing or spawning habitat, or these essential behaviors. A discussion of how each PCE is affected by Project activities is provided below.

An earlier section identified the PCEs of bull trout critical habitat and described their baseline condition in the action area (*Status of Critical Habitat in the Action Area*). The following sub-sections discuss the effects of the action with reference to the four PCEs which are present and may be affected.

PCE 1) Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

The Project will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function.

PCE 2) Migratory habitat with minimal physical, biological, or water quality impediments.

The Project will result in temporary and permanent adverse effects to this PCE. Construction activities will temporarily impair function of the migratory corridor surrounding the Project (impact pile driving below the MHHW; pile removal and installation; dredging; stone column installation), intermittently over three years (2015-2017) during the in-water work window (July 15 to February 15). Installation of structures in the nearshore (terminal, trestle, wingwalls, dolphins, and fishing pier) introduces new physical impediments to migration within the nearshore environment in perpetuity. However, in the long-term, despite these new structures, the Project will result in the beneficial effect of fewer structures in the nearshore environment by removing the Tank Farm Pier and existing ferry terminal structures. And finally, releases of stormwater constituents into the nearshore environment from pollution generating impervious

surface will continue in perpetuity. The effects of these constituents to water and habitat (via metals concentrations and loading) in the marine environment are expected to be confined to the immediate vicinity (50 ft) of the outfalls. All other Project elements and activities will result in no measurable effects to short or long term function of this PCE. We expect that the Project will maintain the current level of function for this PCE.

PCE 3) Abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish: There is no large overhanging woody vegetation. The existing conditions within the defined area of critical habitat consist of mostly large and small cobble to the west of the ferry terminal, large and small cobble inshore of the MLLW line, and sand/mud with some wood debris to the east of the ferry terminal (MRC 2000). Riprap and seawalls are adjacent to the ferry terminal. Macroalgae occurs in the vicinity; eelgrass is sparse to absent.

The Project will result in temporary and permanent adverse effects in addition to beneficial permanent effects to this PCE. Features included in the Project (i.e., tank farm pier removal, permanent piling, overwater structures) will result in temporary adverse effects to native substrate and associated epibenthic and infaunal communities. Temporary adverse effects to nearly 4 acres of nearshore habitat will persist for a term of approximately 3 years. Permanent adverse effects (445 ft^2 of benthic impacts, 21,106 ft^2 of overwater cover, and distribution of potentially contaminated sediments within a 1,800 ft drift cell), will persist indefinitely or for the functional life of the constructed features. However, compared to the current area of benthic impacts (3,315 ft^2) and overwater coverage (150,238 ft^2), these areas represent significant reductions in benthic impacts (2,870 ft^2) and overwater cover (129,132 ft^2) resulting in long-term improvements to habitat conditions. The degree to which redistribution of contaminated sediments could affect benthic organisms or result in food chain bioaccumulation cannot be accurately predicted. Removal of the existing ferry terminal, which is currently located in suitable forage fish spawning habitat, will provide additional spawning habitat for sand lance and potentially other forage fish species. All other Project elements and activities will result in no measurable effects to short or long term function of this PCE. Given the nature, size, and duration of these effects, we expect that within the action area this PCE will retain its current level of function.

PCE 5) Water temperatures ranging between 2 to 15°C (36 to 59°F), with adequate thermal refugia available for temperatures at the upper end of the range.

The Project will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function.

PCE 8) Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited: The marine waters of Possession Sound near the ferry terminal are designated "Extraordinary" for aquatic life use per WAC 173-201(a).

The Project will result in temporary and permanent (stormwater) adverse effects to this PCE. Construction activities will impair water quality (pile installation and removal, stone column installation, dredging), intermittently over approximately three years (2015-2017), during the in-

water work windows (July 15 to February 15). Permanent stormwater releases will affect water and habitat quality up to 50 ft from each of the outfalls in perpetuity. All other Project elements and activities will result in no measurable effects to short or long term function of this PCE. We expect that the Project will have no measurable, permanent effects to this PCE, and within the action area this PCE will retain its current level of function.

In summary, we expect that the action will result in adverse effects to critical habitat resulting from temporary and permanent adverse effects to PCEs #2 (migration habitats with minimal impediments), PCE #3 (food base), and #8 (water quantity and quality), but that the extent of these impacts will not destroy or adversely modify bull trout critical habitat. The critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

CUMULATIVE EFFECTS (Bull Trout and Critical Habitat)

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

A summary of projects that are reasonably certain to occur in the action area is provided in the table below:

Project	Potential cumulative effects	Project proponent
Redevelopment of holding areas at existing terminal The area currently occupied by ferry holding lanes would be redeveloped. Redevelopment would likely be a mix of commercial and residential units.	None: The holding lanes do not provide habitat for any listed species. Future development could result in potential reduction in PGIS or improvements in stormwater runoff treatment.[1]	TBD-Private entities
Mount Baker Crossing This project would create an improved at-grade crossing of the BNSF railroad track connecting Mukilteo Lane to the Tank Farm.	None: The project area does not provide habitat for any listed species.	Port of Everett
City of Mukilteo Lighthouse Park Improvements Project Phase 3 of this project includes improvements to Front Street, completion of the park driveway and construction of the parking area in the southeast corner of the site.	This project would create additional PGIS, potentially increasing pollutant loading to Possession Sound. Impacts would be offset or minimized by designing the project according to appropriate city and county stormwater codes.	City of Mukilteo

[1] There are approximately 2 acres of PGIS at the existing terminal, half of which receives basic treatment and the remaining half receives no treatment prior to releasing to the Puget Sound. Runoff from these areas results in 477 lb/yr of Total Susupended Solids, 0.14 lb/yr of total copper (Cu), 0.048 lb/yr of dissolved Cu, 0.813 lb/yr of total zinc (Zn), and 0.308 lb/yr of dissolved Zn. Redevelopment would likely replace some of this area with non-pollution generating impervious surface, or would result in the retrofit of existing PGIS treatment systems to meet current regulatory standards. At present, it is not possible to quantify future impacts associated with these changes.

The projects above that will increase existing PGIS have the potential to further degrade the existing environmental baseline via additional stormwater runoff and resultant increases in loading and possibly stormwater constituent concentrations to Possession Sound. If these projects result in additional in-water structures or overwater cover, they could also further degrade baseline aquatic habitat conditions or habitat suitability or availability in the action area. If these projects are limited to upland areas and reduce PGIS or result in improved stormwater runoff treatment, they could help to maintain or even slightly improve the existing baseline conditions in the action area or Possession Sound. Upland habitat impacts associated with these projects will have insignificant impacts on listed species due to the limited suitability of habitats in the action area.

Climate Change

There is now widespread consensus within the scientific community that atmospheric temperatures on earth are increasing and that effects from climate change will continue for at least the next several decades (IPCC 2007, pp. 2, 7-9). There is also consensus within the scientific community that this warming trend will alter current weather patterns and climatic phenomena, including the timing and intensity of extreme events such as heat waves, floods, storms, and wet-dry cycles.

Recent observations and modeling for Pacific Northwest aquatic habitats suggest that bull trout and other salmonid populations will be negatively affected by ongoing and future climate change. Rieman and McIntyre (1993, p. 8) listed several studies which predicted substantial declines of salmonid stocks in some regions related to long term climate change. More recently, Battin et al. (2007, pp. 6721-6722) modeled impacts to salmon in the Snohomish River Basin related to predictions of climate change. They suggest that long term climate impacts on hydrology would be greatest in the highest elevation basins, although site specific landscape characteristics would determine the magnitude and timing of effects. Streams fed by snowmelt and rain-on-snow events may be particularly vulnerable to the effects of climate change (Battin et al. 2007, p. 6724). Warming air temperatures are predicted to result in receding glaciers, which in time would be expected to seasonally impact turbidity levels, timing and volume of flows, stream temperatures, and species response. Changing climatic conditions are expected to similarly affect other North Puget Sound basins.

With the impacts of climate change, habitat connectivity and thermal refugia may become even more important to the growth and survival of fluvial and anadromous bull trout. If the current climate change models and predictions for Pacific Northwest aquatic habitats are accurate, bull trout may be affected by the following:

- Changes in distribution, reduced spawning habitat, and/or seasonal thermal barriers along migratory corridors resulting from increased stream temperatures.
- Short or long term changes in habitat and prey species availability due to larger or more frequent stochastic events.
- Shifts in seasonal availability of prey, resulting from changes in flow and the timing of out-migration.

CONCLUSION

After reviewing the current status of bull trout, the environmental baseline for the action area, the effects of the Project, and the cumulative effects, it is the USFWS's Biological Opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the bull trout, and is not likely to destroy or adversely modify designated critical habitat. We have reached these conclusions for the following reasons.

Affected bull trout may originate from the Skagit, Snohomish/Skykomish or Stillaguamish bull trout core areas. Given the small number of bull trout affected, we expect that no measurable effect to numbers (abundance) will be evident at the scale of any local population or core area. We also expect that for most exposed bull trout, potential incremental effects to growth and long term survival will not be measurable, and there will be no measurable effect to numbers (abundance) or reproduction (productivity) that will be evident at the scale of local populations or core areas. Any measurable effects to migratory habitat (or migrating individuals) will be temporary, and is not expected to result in measurable short or long term effects to distribution.

The action will result in adverse effects to critical habitat associated with temporary and permanent adverse effects to PCEs #2 (migration habitats with minimal impediments), PCE #3 (food base), and #8 (water quantity and quality). Given the nature, size, and duration of these effects, we expect that critical habitat in the action area, the critical habitat unit, and rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. *Harm* is defined by the USFWS as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the USFWS as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the FTA so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The FTA has a continuing duty to regulate the activity covered by this incidental take statement. If the FTA 1) fails to assume and implement the terms and conditions or 2) fails to require the (applicant) to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, FTA or WSF must report the progress of the action and its impact on the species to the USFWS as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

The USFWS anticipates that take in the form of harm and harassment of adult and subadult bull trout from the Skagit, Stillaguamish, and Snohomish/Skykomish core areas will result from the Project.

The USFWS expects that incidental take of bull trout will be difficult to detect or quantify for the following reasons: 1) the low likelihood of finding dead or injured individual; 2) delayed mortality, and 3) losses may be masked by seasonal fluctuations in numbers. Where this is the case, we use a description of the affected habitat (i.e., physical extent, frequency and duration) and the intensity of temporary exposures as a surrogate indicator of take.

1. Incidental take of up to 2 sub-adult or adult bull trout in the form of harm from exposure to elevated turbidity and sedimentation, from pile removal activities at the Tank Farm Pier, resulting in gill abrasion and/or reduced respiratory function.

    - Take will persist for up to seven months of the in-water work window in 2015-2016 (as modified by NMFS for pile removal activities to July 15 to February 15) within 150 ft of the Tank Farm Pier.
    - Take will persist for up to seven months of the in-water work window in 2016-2017 (as modified by NMFS for pile removal activities to July 15 to February 15) within 150 ft of the Tank Farm Pier.

2. Incidental take of up to 2 sub-adult or adult bull trout in the form of harm from exposure to elevated contaminant concentrations, from pile removal and installation, stone column installation, and dredging, resulting in reduced endocrine function and/or development or other physiological injury.

    - During pile removal and installation, take will persist for:
        - Up to seven months of the 2015-2016 in-water work window within 150 ft of the tank farm pier, new trestle and bulkhead, and new passenger building.
        - Up to seven months of the 2016-2017 in-water work window within 150 ft of the tank farm pier, pedestrian overhead loading structure, transfer span, wingwalls and inner dolphins.
        - Two months of the 2017-2018 in-water work window within 150 ft of the existing terminal, existing terminal pier and fishing pier.
    - During stone column installation, take will persist for 30 days during the 2015-2016 in-water work window within 177 ft of stone columns.
    - During dredging, take will persist for 30 days during the 2015-2016 in-water work window (as modified by NMFS for dredging to November 1-February 15) up to 150 ft from dredge prism.

3. Incidental take of bull trout in the form of harassment from elevated contaminant concentrations during construction inhibiting the ability of individual bull trout to successfully feed, move, and/or shelter.

Harassment of all adult and subadult bull trout will occur:

- Within 150 ft of the Tank Farm Pier between July 15 and February 15 during the first and second in-water construction windows and for two months during the third July 15 to February 15 in-water construction window;
- Within 150 ft of the dredge prism for up to 30 days between November 1 and February 15 during the first in-water construction window; and
- Within 177 ft of the stone columns for up to 30 days during the first July 15 to February 15 in-water construction window.

EFFECT OF THE TAKE

In the accompanying Opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Project incorporates design elements and conservation measures which we expect will reduce permanent effects to habitat and avoid and minimize impacts during construction. We expect that the FTA and WSF will fully implement these measures and therefore they have not been specifically identified as Reasonable and Prudent Measures (RPM) or Terms and Conditions. The USFWS believes the following RPMs are necessary and appropriate to minimize the impact of incidental take of bull trout:

1. Minimize and monitor incidental take caused by elevated turbidity and sedimentation during construction.

2. Minimize and monitor incidental take caused by elevated contaminant concentrations during and resulting from construction.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the FTA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions are required for the implementation of RPM 1:

1. The FTA and WSF will submit a monitoring report to the USFWS Washington Fish and Wildlife Office in Lacey, Washington by April 1 following each construction season. The report shall include, at a minimum, the following: (a) dates, times and locations of construction activities, (b) monitoring results, sample times, locations and measured turbidities (in NTUs), (c) summary of construction activities and measured turbidities associated with those activities, and (d) summary of corrective actions taken to reduce turbidity.

The following terms and conditions are required for the implementation of RPM 2:

1. The FTA and WSF will submit a monitoring report to the USFWS Washington Fish and Wildlife Office in Lacey, Washington by April 1 following each construction season. The report shall include, at a minimum, the following: (a) dates, times and locations of construction activities, (b) monitoring results, sample times, locations and analytical results, (c) summary of construction activities and measured water chemistry and trubidity associated with those activities, and (d) summary of corrective actions taken to reduce water chemistry effects and turbidity.

2. The FTA and WSF shall document all waste handling, containment, testing, storage, treatment and disposal operations according to all applicable State and Federal requirements. The FTA shall submit a monitoring report to the USFWS Washington Fish and Wildlife Office in Lacey, Washington (Attn: Transportation Branch), by April 1 following each construction season. The report shall include, at a minimum, the following: (a) a description of the treatment facilities and/or BMPs utilized on site, (b) a quantitative waste characterization or profile for any sediments and water disposed at an in-water dredged material disposal site, and (c) a summary of corrective actions taken to minimize or contain the spread of contaminants.

The USFWS believes that no more than 4 bull trout will be harmed, and all bull trout associated with the extent of habitat described above will be harassed, as a result of the Project. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the Project. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the USFWS the need for possible modification of the reasonable and prudent measures.

The USFWS is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of

sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the USFWS Washington Fish and Wildlife Office at (360) 753-9440.

CONSERVATION RECOMMENDATIONS

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

Because so little is known about the impacts associated with installation of stone columns in the marine or near shore environment. The USFWS recommends that FTA and WSF design a hydroacoustic and water quality monitoring program to better understand the effects of this building technology in aquatic environments.

The Project could affect the distribution of sediments via sediment transport as a result of removal of the Tank Farm Pier. The sediments that could be mobilized contain creosote and potentially a variety of other contaminants at various sediment depths. The USFWS recommends that FTA and WSF monitor the potentially affected drift cell before and after construction for a period of 5 to 10 years to discern any changes in sediment quality and quantity, habitat characteristics and suitability for forage fish, and benthic community and vegetative growth or distribution.

The Project will remove thousands of creosote piles. The Project presents a unique opportunity to better understand the short term and long term effects associated with removal of creosote piles in the marine environment. The USFWS recommends that FTA and WSF develop, or collaborate with another entity to develop a comprehensive study to examine the short and long term effects on water quality, sediment quality, and biological resources associated with removal of creosote piles.

The Project will increase impervious surface and the loading of metals to Possession Sound, thereby adversely affecting the environmental baseline within the action area in perpetuity. To minimize these impacts, the USFWS requests the FTA and WSF to utilize high efficiency sweeping in the existing holding lane area on a quarterly basis to reduce the stormwater inputs and loading generated within the action area, until such time that the existing holding area is redeveloped and/or stormwater treatment for these impervious areas is retrofitted or enhanced. The USFWS also requests the FTA and WSF to implement the programmatic approach to monitoring stormwater detailed in “Programmatic Monitoring Approach for Highway Stormwater Runoff in Support of Endangered Species Act Section 7 Consultations.” The sites selected for this programmatic monitoring approach shall be representative of conditions within the action area, including average daily traffic and seasonal and temporal variations in

stormwater runoff quantity and quality. If the programmatic monitoring shows that the analysis performed of this project has underestimated the end of pile effluent concentrations or the size of the dilutions zones then the reinitiation of consultation may be necessary.

In order for the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the USFWS requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the Mukilteo Multimodal project. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

LITERATURE CITED

Abbott, R.R., E. Bing-Sawyer, and R. Blizard. 2002. Assessment of pile driving impacts on the Sacramento blackfish (*Orthodon microlepidotus*). Caltrans, , Report Administrative draft, Oakland, California. October 10, 2002. 16 pp.

Abbott, R.R., J.A. Reyff, and G. Marty. 2005. Monitoring the effects of conventional pile driving on three species of fish. Strategic Environmental Consulting for Manson Construction Company, Report Final Report, Richmond, California. April 8, 2005. 131 pp.

AEHA. 1982. Geohydrologic Study, No. 38-26-0203-83; Defense Fuel Support Point Mukilteo, Washington. U.S. Army Environmental Hygiene Agency. July 17, 1982 (as cited in Ebasco 1992).

AEHA. 1984. Environmental Quality Survey and Spill Plans Implementation Review, Study No. 32-24-1349-85, Defense Fuel Support Point Mukilteo, Mukilteo, Washington. U.S. Army Environmental Hygiene Agency. August 23, 1984 (as cited in Ebasco 1992).

Bash, J., C.H. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. Center for Streamside Studies, University of Washington, Seattle, WA. November 2001. 72 pp.

Berg, L., and T.G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Bridges, T.S., S. Ells, D. Hayes, D. Mount, S.C. Nadeau, M.R. Palermo, and C. Patmont. 2008. The four Rs of environmental dredging resuspension, release, residual, and risk. US Army Corps of Engineers, , Report ERDC/EL TR-08-4, Washington, DC. Feb 2008. 63 pp.

Brooks, K.M. 1994. Assessment of the environmental risk of creosote-treated wood products in aquatic environments. Aquatic Environmental Sciences, Port Townsend, Washington, 8/30/1994,136 pp.

Brooks, K.M. 2000. Assessment of the environmental effects of wooden bridges preserved with creosote, pentachlorophenol, or chromated copper arsonate. FPL-RP-587, Research paper. USDA Forest Service, Forest Products Laboratory, Madison, Wisconsin, 100 pp.

Burgess, R.M. 2007. Evaluating Ecological risk to Invertebrate Receptors from PAHs in Sediment at Hazardous Waste Sites. U.S. Environmental Protection Agency, Office of Research and Development. Narrangansett, Rhode Island.

Burton, G.A., R. Pitt, and S. Clark. 2000. The role of traditional and novel toxicity test methods in assessing stormwater and sediment contamination. Critical Reviews in Environmental Science and Toxicology 30(4):413-447.

CALTRANS. 2007. Update on Recommendations for Revised Interim Sound Exposure Criteria for Fish during Pile Driving Activities. CALTRANS, , Report CALTRANS-Arlington Memo Update 12-21-07, Arlington, VA. December 21, 2007. 8 pp.

Carlson, T.J., G. Ploskey, R.L. Johnson, R.P. Mueller, M.A. Weiland, and P.N. Johnson. 2001. Observations of the behavior and distribution of fish in relation to the Columbia River navigation channel and channel maintenance activities. U.S. Army Corps of Engineers, , Report PNNL-13595, Portland, Oregon. October 2001. 38 pp.

Cederholm, C.J., and L.M. Reid. 1987. Impact of forest management on coho salmon (*Oncorhynchus kisutch*) populations of the Clearwater River, Washington: A project summary. Pages 373-398 *In* E.O. Salo, and T.W. Cundy, eds. Streamside management: Forestry and fishery interactions. University of Washington Institute of Forest Resource Contribution 57.

CENPS. 1950. USAF Petroleum Storage Depot, Mukilteo: Military Reservation Real Estate. Drawing No. SE-RE-7.3. U.S. Army Corps of Engineers, Seattle District. August 17, 1950 (as cited in Ebasco 1992).

CENPS. 1983. Fire Protection System Defense Fuel Support Point Mukilteo, WA. Plan and Boring Logs. PN MUK-0001. File No. 53-411-20-04. Sheet 2 (as cited in Ebasco 1992).

CENPS. 1985. Clean, Paint, and Repair Tanks 9 and 10, Mukilteo, Washington. Project No. MUK 85-1. Foundation and Materials Branch, U.S. Army Corps of Engineers, Seattle District. September 16, 1985 (as cited in Ebasco 1992).

Chan, .J. 2012. Personal communication via email between Jeffrey Chan, United States Fish and Wildlife Service and Julie Hampden, Herrera Environmental Consultants. November 6, 2012.

Coast and Harbor Engineering. 2012a. Elliot Point 2, Mukilteo Ferry Terminal Pile Removal, Dredging, and Stone Column Installation – Temporary Effects on Water Quality. Draft Technical Memorandum. 16 pp.

Coast and Harbor Engineering. 2012b. Hydrodynamic and Sediment Transport Modeling Study – Mukilteo Ferry Terminal. 92 pp.

Crum, L.A., and Y. Mao. 1996. Acoustically enhanced bubble growth at low frequencies and its implications for human diver and marine mammal safety. Journal of the Acoustical Society of America 99(5):2898-2907.

Curl, Jr., H.C., E.T. Baker, T.S. Bates, G.A. Cannon, R.A. Feely, T.L. Geiselman, M.F. Lamb, P.P. Murphy, D.J. Pashinski, A.J. Paulson, and D.A. Tennant. 1988. Contaminant transport from Elliott Bay and Commencement Bay. National Oceanic and Atmospheric Administration (NOAA).

Davidson, M. 2004. Transmission loss. Pages lecture structure obtained from website *in* IOM. Studies, editor. University of Plymouth, Drake Circus, Plymouth, Devon, UK.

Department of Natural Resources (DNR). 2008. Brief Science of Creosote. Washington State Department of Natural Resources. Available on-line at: http://www. dnr.wa. gov/Publications/aqr_cleanup creosote-brief.pdf

Ebasco. 1992. Remedial Investigations and Feasibility Studies at Defense Fuel Support Point Mukilteo, Mukilteo, Washington – Part 1: Preparation of Project Performance Documents and Preliminary Investigations. Final Project Scoping Document, Version 3.0. Report prepared for Huntsville Division, Region 8, U.S. Army Corps of Engineers. Prepared by Ebasco Services, Inc. of Bellevue, Washington, and Shannon & Wilson, Inc. of Seattle, Washington. May 8, 1992.

Ecology. 2001/2003. Sediment Cleanup Status Report (general information regarding status of sediment cleanup sites identified throughout the Puget Sound region, including the DFSP Mukilteo site). Washington Department of Ecology, Toxic Cleanup Program, Sediment Management. April 2001 publication no. 01-09-046 and June 2003 publication no. 03-09-086. Viewed publications online at the website: http://www.ecy.wa.gov/programs/tcp/smu/sediment.html.

Ecology, Department of. 2010. Water Quality Assessment for Washington. Accessed March 20, 2012. https://fortress.wa.gov/ecy/wqamapviewer/default.aspx?res=1280x1024

EDGe. 1989. Preliminary Assessment, Defense Fuel Support Point Mukilteo, Mukilteo, Washington. Prepared for the U.S. Environmental Protection Agency by Engineering, Design & Geosciences Group, Inc. August 1989 (as cited in Ebasco 1992).

Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a synoptic review. Biological Report 85. U.S. Fish and Wildlife Service.

Eisler, R. 1990. Chlordane Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service Patuxent Wildlife Research Center. Laurel, Maryland 20708.

Ellis, J.B. 2000. Risk assessment approaches for ecosystem responses to transient pollution events in urban receiving waters. Chemosphere 41(1-2):85-91.

Feist, B.E., J.J. Anderson, and R. Miyamoto. 1992. Potential impacts of pile driving on juvenile pink (*Onchorhynchus gorbuscha*) and chum (*O. keta*) salmon behavior and distribution. University of Washington, Seattle, WA. May 1992. 58 pp.

Fewtrell, J.L. 2003. The response of marine finfish and invertebrates to seismic survey noise. Doctoral thesis. Curtin University of Technology, Perth, Australia.

FHWG. 2008. Agreement in principle for interim criteria for injury to fish from pile driving activities. . June 12, 2008.

Germain, A., F. Perron, and R. Van Coillie. 1993. PAH in the environment: Fate, ecotoxicity, and regulations, Supporting Document No. 3. Environment Canada, Montreal, Quebec.

Gisiner, R.C., E. Cudahy, G.V. Frisk, R. Gentry, R. Hofman, A.N. Popper, and J.W. Richardson. 1998. Effects of anthropogenic noise in the marine environment. Pages 1-141 In Gisiner, R.C. ed. Workshop on the effects of anthropogenic noise in the marine environment, February 10-12, 1998, Marine Mammal Science Program, Office of Naval Research, Arlington, VA. 141 pp.pp.

Goetz, .F. 2007. Personal communication via email between Fred Goetz, United States Army Corps of Engineers and Nancy Brennan-Dubbs, USFWS. January 17, 2007.

Goetz, F.A., E. Jeanes, and E. Beamer. 2004 Bull Trout in the Nearshore- Preliminary Draft. June 17, 2004.

Goetz, F.A., E. Connor, E. Jeanes, and M. Hayes. 2012. Powerpoint presentation on "Migratory Patterns and Habitat Use of Bull trout in the Puget Sound."

GTI. 1994. Preliminary Draft Remedial Investigation Report, Defense Fuel Support Point Mukilteo, 1 Front Street, Mukilteo, Washington. Report prepared for the Defense Fuel Supply Center, DFSC-PSA, Cameron Station, Alexandria, Virginia, by Groundwater Technology Government Services, Inc. of Kent, Washington. August 24, 1994.

GTI. 1998. Compliance Monitoring Plan, Defense Fuel Supply Point Mukilteo, 1 Front Street, Mukilteo, Washington. Plan prepared for the Defense Fuel Supply Center, FESC-FPA, Fort Belvoir, Virginia by Fluor Daniel GTI, Inc. of Kent, Washington. December 1998.

GTI. 2002. Addendum 1 to Compliance Monitoring Plan—Defense Fuel Supply Point Mukilteo, 1 Front Street, Mukilteo, Washington; Marine Sediment Sampling and Analysis Plan for Compliance Monitoring. Prepared for Defense Energy Support Center, DESC-FPA of Fort Belvoir, Virginia by Groundwater Technology, Inc. of Bothell, Washington. November 2002.

Hastings, M.C. 2002. Clarification of the meaning of sound pressure levels and the known effects of sound on fish. Ohio State University, Columbus, OH. August 26, 2002. 6 pp.

Hastings, M.C., and A.N. Popper. 2005. Effects of sound on fish. California Department of Transportation, , Report Contract No. 43A0139, Task Order, 1, Sacramento, CA. January 28, 2005. 82 pp.

Hawkins, A.D., and A.D.F. Johnstone. 1978. The hearing of the Atlantic Salmon, *Salmo salar*. Journal of Fish Biology 13(6):655-673.

Herrera. 2003a. Water Resources Technical Report – Mukilteo Multimodal Project. Mukilteo, Washington. Prepared for Jacobs Civil Inc. and Washington State Ferries by Herrera Environmental Consultants. December 2003.

Herrera. 2003b. Hazardous Materials Site Assessment – Former Defense Fuel Support Point, Mukilteo Property, Mukilteo, Washington. Prepared for Jacobs Civil Inc. and Washington State Ferries by Herrera Environmental Consultants. December 2003.

Hodson, P.V. 1988. Effect of metal metabolism on uptake, disposition, and toxicity in fish. Aquatic Toxicology 11(1-2):3-18.

Johnson, L.L., T.K. Collier, and J.E. Stein. 2002. An analysis in support of sediment quality thresholds for polycyclic aromatic hydrocarbons (PAHs) to protect estuarine fish. Aquatic Conservation: Marine and Freshwater: Ecosystems I 2: 5 1 7-3 8.

Karrow, N.H., D.D. Boermans, A.Hontella, K.Solomon, J.Whyte, andN.Bols. 1999. Characterizing the immunotoxicity of creosote to rainbow trout (Oncorhynchus mykiss): a microcosm study. Aquatic Toxicology 45.

Knudsen, F.R., P.S. Enger, and O. Sand. 1992. Awareness reactions and avoidance responses to sound in juvenile Atlantic salmon, *Salmo salar* L. Journal of fish biology 40(4):523-534.

Knudsen, F.R., C.B. Schreck, S.M. Knapp, P.S. Enger, and O. Sand. 1997. Infrasound produces flight and avoidance responses in Pacific juvenile salmonids. Journal of fish biology 51(4):824-829.

Krahn, MM., L.D. Rhodes, M.S. Myers, L.K. Moore, W.D. Macleod, and D.C. Malins. 1986. Associations between metabolites of aromatic compounds in bile and the occurrence of hepatic lesions in English sole (Parophrys vetulus) from Puget Sound, Washington. Arch environ contam toxicol 15.

Lance, M.M., S.F. Pearson, and M.G. Raphael. 2008. 2007 at-sea marbled murrelet population monitoring: research progress report. Washington Department of Fish and Wildlife, Wildlife Science Division, Olympia, WA. January 2008. 24 pp.

Lance, M.M., S.F. Pearson, M.G. Raphael, and T.D. Bloxton. 2009. 2008 at-sea marbled murrelet population monitoring: research progress report. Washington Department of Fish and Wildlife, Wildlife Science Division, Olympia, WA. March, 2009. 17 pp.

Laughlin, J. 2011a. Personal communication to Rick Huey (WSDOT/WSF) on June 14, 2011.

Laughlin, J. 2011b. Port Townsend Dolphin Timber Pile Removal – Vibratory Pile Monitoring Technical Memorandum. Prepared by Washington State Department of Transportation, Office of Air Quality and Noise, Seattle, Washington. January 2011.

Laughlin, J. 2012. Personal communication from Jim Laughlin (WSDOT) to George Ritchotte (WSDOT) on March 19, 2012.

Lawrence, J.F. and D.F. Weber. 1984. Determination of polycyclic aromatic hydrocarbons in some Canadian commercial fish, shellfish, and meat product by liquid chromatography with confirmation by capillary gas chromatography-mass spectrometry. J. Agric. Food Chem. 32:789-794

Lloyd, R. 1987. Special tests in aquatic toxicity for chemical mixtures: Interactions and modifications of response by variation of physicochemical conditions. Pages 491-507 *In* V.B. Vouk, G.C. Butler, A.C. Upton, D.V. Parke, and S.C. Asher, eds. Methods for assessing the effects of mixtures of chemicals.Laughlin, J. 2007. Underwater sound levels associated with driving steel and concrete piles near the Mukilteo Ferry Terminal. Prepared by Washington State Department of Transportation, Office of Air Quality and Noise, Seattle, WA. March 2007.

Malins, D., et al. 1985. Toxic Chemicals in Marine Sediment and Biota from Mukilteo, Washington: Relationships with Hepatic Neoplasms and Hepatic Lesions in English Sole (Parophrys vetulus). Journal of the National Cancer Institute, Vol. 74, No. 2. February 1985 (as cited in Ebasco 1992).

Marsalek, J., Q. Rochfort, B. Brownlee, T. Mayer, and M.R. Servos. 1999. An exploratory study of urban runoff toxicity. Water Science and Technology 39(12):33-39.

McElroy, A.E., J.M. Cahill, J.D. Sisson, and K.M. Kleinow. 1991. Relative bioavailability and DNA adduct formation of benzo[a]pyrene and metabolites in the diet of the winter flounder. Comp Biochem Physiol l00C(1/2).

Meador, J.P., Stein, J.E., Reichert, W.L., Varanasi, U. 1995. A review of bioaccumulation of polycyclic aromatic hydrocarbons by marine organisms. Reviews in Environmental Contamination and Toxicology 143: 79-165.

MEL. 1991. Mukilteo Defense Fuel Supply Point: Samples 91037334 – 91037335. Case No. DOE-940D. Manchester Environmental Laboratory. March 6, 1991 (as cited in Ebasco 1992).

Mesa, M.G. 1994. Effects of multiple acute stressors on the predator avoidance ability and physiology of juvenile Chinook salmon. Transactions of the American Fisheries Society 123(5):786-793.

Mongillo, P.E. 1993. The distribution and status of bull trout/dolly varden in Washington state. Washington Department of Wildlife, Report 93-22, Olympia, WA. 1993. 45 pp.

Mueller, R.P., D.A. Neitzel, and W.V. Mavros. 1998. Evaluation of low and high frequency sound for enhancing fish screening facilities to protect outmigrating salmonids. U.S. Department of Energy, Bonneville Power Administration, , Report BPA Report DOE/BP-62611-13, Portland, Oregon. February 1998. 26 pp.

Nedwell, J., and B. Edwards. 2002. Measurements of underwater noise in the Arun River during piling at County Wharf, Littlehampton. Subacoustech Ltd, , Report Report No. 513 R 0108, Hampshire, UK. August 01, 2002. 25 pp.

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16(4):693-727.

Newcombe, C.P., and D.D. MacDonald. 1991. Effects of Suspended Sediments on Aquatic Ecosystems. North American Journal of Fisheries Management 11(1):72-82.

Norman. 1979a. Drainage Improvements, Defense Fuel Support Point Mukilteo, Washington. Tanks 1, 2, and 3 (Sheet 3); Tanks 4 through 8 (Sheet 4); and Tanks 9 and 10 (Sheet 5). Project MUK 79-6. Norman Associates, Inc. (as cited in Ebasco 1992).

Norman. 1979b. Report on Tank Dike Survey, Defense Fuel Supply Point Mukilteo, Washington. Project MUK 79-5. Norman Associates, Inc. September 1979 (as cited in Ebasco 1992).

OAG. 1990. Remedial Action Order No. DE 90-N209. Ecology Division (PV-11), Office of the Attorney General, Olympia, Washington. August 7, 1990 (as cited in GTI 1994).

Parsons. 1951. Demolition Plan – Bulk Petroleum Storage Facilities, Mukilteo, Washington. The Ralph M. Parsons Company. May 26, 1951 (as cited in Ebasco 1992).

Pearson, S.F., M.G. Raphael, M.M. Lance, and T.D. Bloxton. 2010. Washington 2009 at-sea marbled murrelet population monitoring: research progress report. Washington Department of Fish and Wildlife, Wildlife Science Division and USDA Forest Service Pacific Northwest Research Station, Olympia, WA. March 2010. 14 pp.

Pentec. 2004. Revised Draft Port of Everett Rail/barge Transfer Facility. Biological Evaluation. Everett, Washington. Prepared for Berger/Abam Engineers, Inc. and the Port of Everett. March 3, 2004.

Popper, A.N. 2003. Effects of anthropogenic sounds of fishes. Fisheries 28(10):24-31.

Popper, A.N., T.J. Carlson, A.D. Hawkins, B.L. Southall, and R. Gentry. 2006. Interim criteria for injury of fish exposed to pile driving operations: A white paper. , Report pile driving Interim Criteria 5-13-06, . May 13, 2006. 15 pp.

Santulli, A., A. Modica, C. Messina, L. Ceffa, A. Curatolo, G. Rivas, G. Fabi, and V. D'Amelio. 1999. Biochemical responses of European sea bass (*Dicentrarchus labrax* L.) to the stress induced by off shore experimental seismic prospecting. Marine pollution bulletin 38(12):1105-1114.

Shin, H.O. 1995. Effect of the piling work noise on the behavior of snakehead (*Channa argus*) in the aquafarm. Journal of the Korean Fisheries Society 28(4):492-502.

Smith, P.T. 2008. Risks to human health and estuarine ecology posed by pulling out creosote-treated timber on oyster farms. Aquatic Toxicology 86: 287-298.

Snohomish County. 2012. Snohomish County Comprehensive Plan. Available online at http://www1.co.snohomish.wa.us/Departments/PDS/Divisions/PlanningandTechnology/LR_Planning/Projects_Programs/Comprehensive_Plan/General_Policy_Plan.htm

Sommers. 2012. Behavioral response of juvenile Chinook salmon (Oncorhynchus tshawytscha) to combinations of dissolved copper and submerged structure in freshwater and seawater. Master's Thesis, Evergreen State College.

Speich, S.M., and T.R. Wahl. 1995. Marbled murrelet populations of Washington -- marine habitat preferences and variability of occurrence. , Report USDA Forest Service Gen. Tech Rep. PSW-152, .

Sprague, J.P. 1968. Avoidance reactions of rainbow trout to zinc sulphate solutions. Water Research 2: 367-372.

Stadler, J.H. 2002. Notes from site visit, Winslow Ferry Terminal, to observe pile driving and monitoring of noise levels and effects to fishes.

Stadler, J.H. 2009. Guidance on applying SEL interim criteria spreadsheet for pile driving projects.

Stein, J.E., W.L. Reichert, M. Nishimoto, and U. Varanasi. 1990. Overview from Studies on Liver Carcinogenesis in English Sole from Puget Sound; Evidence for a Xenobiotic Chemical Etiology II: Biochemical Studies. The Science of the Total Environment 94..

Stotz, T., and J. Colby. 2001. January 2001 dive report for Mukilteo wingwall replacement project. Washington State Ferries, Report Memorandum, Seattle, WA. April 30, 2001. 19 pp.

Stratus Consulting Inc. 2006. Creosote-Treated Wood in Aquatic Environments: Technical Review and Use Recommendations. Prepared for; NOAA Fisheries Southwest Division.

Stroetz, R.W., N.E. Vlahakis, B.J. Walters, M.A. Schroeder, and R.D. Hubmayr. 2001. Validation of a new live cell strain system: Characterization of plasma membrane stress failure. Journal of applied physiology 90(6):2361-2370.

Tetra Tech. 1994. Sediment and Shellfish Investigation at Defense Fuel Support Point (DFSP), Mukilteo, Washington. Prepared for Groundwater Technology Government Services, Inc. of Kent, Washington by Tetra Tech, Inc. of Redmond, Washington. October 26, 1994.

Tetra Tech. 2001. City of Mukilteo – Comprehensive Surface Water Management Plan. Report prepared for City of Mukilteo by Tetra Tech/KCM, Inc. of Seattle, Washington. April 2001.

Turnpenny, A.W.H., and J. Nedwell. 1994. The effects on marine fish, diving mammals and birds of underwater sound generated by seismic surveys. Fawley Aquatic Research Laboratories Limited, Marine and Freshwater Biology Unit, , Report FCR 089/94, Southampton, Hampshire, UK. October 1994. 40 pp.

Turnpenny, A.W.H., K.P. Thatcher, R. Wood, and J. Nedwell. 1994. The effects on fish and other marine animals of high-level underwater sound. Fawley Aquatic Research Laboratory, Ltd., Marine and Freshwater Biology Unit, , Report Report FRR 127/94, Southampton, United Kingdom. SOSMM0906; Vashon Island BO ; Navy EOD pp.USACE 2012. Seattle District Dredged Material Management Office reports homepage. http://www.nws.usace.army.mil/Missions/CivilWorks/Dredging/Reports.aspx.

USFWS. 2004. Draft Recovery Plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I: Puget Sound Management Unit, 389+xvii pp and Volume II: Olympic Peninsula Management Unit, 277+xvi pp. Portland, Oregon.

USFWS. 2012. County species listing accessed by George Ritchotte on May 21, 2012. http://www.fws.gov/wafwo/speciesmap/skagit.HTML

USFWS and NMFS. 1998. Final endangered species consultation handbook: Procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act. USFWS and NMFS, , Report U.S. GPO: 2004-690-278, . March 1998. 189 pp.

Varanasi, U., J.E. Stein, and M. Nishimoto. 1989. Biotransformation and disposition of PAHs in fish. In Metabolism of Polycyclic aromatic Hydrocarbons in the Aquatic Environment, Varanasi U (ed.). CRC Press: Boca Raton, FL;93-149.

Vlahakis, N.E., and R.D. Hubmayr. 2000. Plasma membrane stress failure in alveolar epithelial cells. Journal of applied physiology 89:2490-2496.

Walker. 1947. Aerial photograph of the facility. Walker & Associates, Inc. of Seattle, Washington. Photograph number D-47 2. August 24, 1947 (as cited in Ebasco 1992).

Walker. 1955. Aerial photograph of the facility. Walker & Associates, Inc. of Seattle, Washington. Photograph number SNO-55 5S-2. June 9, 1955.

Waters, T.F. 1995. Sediment in streams: Sources, biological effects, and controlAmerican Fisheries Society, Monograph 7, Bethesda, Maryland.

WDFW. 1992. Salmon and Steelhead Stock Inventory (SASSI). Washington Department of Fisheries, Washington Department of Wildlife, and Western Washington Treaty Indian Tribes.

WDFW. 1998. Washington state salmonid stock inventory: bull trout/dolly varden. Washington Department of Fish and Wildlife, Olympia, WA. July 1998. 437 pp.

WDFW. 2004. Forage fish spawning beaches maps. Accessed May 16, 2012.

WDFW. 2007. Washington Lakes and Rivers Inventory System. Fish Distribution. WSDOT GIS Workbench. February 2, 2007.

WDFW. October 08, 2010. Washington state salmonid stock inventory, 2002 Statewide update, 1. Available: http://wdfw.wa.gov/conservation/fisheries/sasi/. (November 15, 2010).

WDFW. 2012. 2012 Pre-season Run Forecasts. http://wdfw.wa.gov/fish/northfalcon/ . Accessed by George Ritchotte, WSDOT May 21, 2012.

Weller, Ken. October 29, 1990. Personal communications between Ken Weller of the U.S. Air Force Aerospace Fuels Laboratory at DFSP Mukilteo and Larry Stuhl and Ron Versaw of Ebasco (as cited in Ebasco 1992).

Weller, Ken. August 8, 1991. Personal communications between Ken Weller of the the U.S. Air Force Aerospace Fuels Laboratory at DFSP Mukilteo and Larry Stuhl of Ebasco (as cited in Ebasco 1992).

West, W.R., P.A. Smith, P.W. Stoker, G.M. Booth, T. Smith-Oliver, B.E. Butterworth and M.L. Lee. 1984. Analysis and genotoxicity of PAC-polluted river sediment. In: M. Cooke and A.J. Dennis (eds.) Polynuclear Aromatic Hydrocarbons: Mechanisms, Methods and Metabolism. Battelle Press, Columbus, OH. p.1395-4I11.

Weston Solutions and Pascoe Environmental Consulting. 2006. Jimmycomelately Piling Removal Monitoring Project. Final Report. March 2006. 109 pp.

WSDOT. 2008. Highway Runoff Dilution and Loading Model User's Guide. Available online at http://www.wsdot.wa.gov/NR/rdonlyres/85B43C71-DEBE-478C-A468-C6BF64D86B64/0/BA_HighwayRunoffUsersGuide.pdf.

WSDOT. 2010. Airborne Noise Measurements (A-weighted and un-weighted) during Vibratory Pile Installation - Technical Memorandum. Jim Laughlin. Washington State Department of Transportation Office of Air Quality and Noise. June 21, 2010. Seattle, WA.

WSDOT. 2012. Biological Assessment Preparation for Transportation Projects. Advanced Training Manual - Version 02-2012. February 2012.

WSDOT. 2012b. Mukilteo Multimodal Project- Sediment Sampling Data Report. Mukilteo, Washington. Prepared for WSDOT/WSF by Parametrix. Novemebr 2012.

Yelverton, J.T., and D.R. Richmond. 1981. Underwater explosion damage risk criteria for fish, birds, and mammals. In Anonymous 102nd Meeting of the Acoustical Society of America, November 30 - December 04, 1981, Department of Biodynamics, Lovelace Biomedical and Environmental Research Institute, Albuquerque, New Mexico. 36 pp.pp.

Yelverton, J.T., D.R. Richmond, R.E. Fletcher, and R.K. Jones. 1973. Safe distances from underwater explosions for mammals and birds. Lovelace Foundation for Medical Education and Research, Albuquerque, NM. September 26, 1973. 64 pp.

Yelverton, J.T., D.R. Richmond, W. Hicks, K. Saunders, and R.E. Fletcher. 1975. The relationship between fish size and their response to underwater blast. Report prepared for the Defense Nuclear Agency, , Report AD-A015-970, Albuquerque, New Mexico. 39 pp.

APPENDIX A: MARBLED MURRELET MONITORING PLAN

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APPENDIX B: STATUS OF THE SPECIES – BULL TROUT

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Appendix B
STATUS OF THE SPECIES (Bull Trout)

Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 2; Brewin and Brewin 1997, p. 215; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 716-719).

Throughout its range, the bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007, pp. 6672-6673; Rieman et al. 2007, p. 1552). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Act relative to this species (64 FR 58910):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Current Status and Conservation Needs

In recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: 1) Jarbidge River, 2) Klamath River, 3) Columbia River, 4) Coastal-Puget Sound, and 5) St.

Mary-Belly River (USFWS 2002a, pp. iv, 2, 7, 98; 2004a, Vol. 1 & 2, p. 1; 2004b, p. 1). Each of these interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

A summary of the current status and conservation needs of the bull trout within these interim recovery units is provided below and a comprehensive discussion is found in the Service's draft recovery plans for the bull trout (USFWS 2002a, pp. vi-viii; 2004a, Vol. 2 p. iii-x; 2004b, pp. iii-xii).

The conservation needs of bull trout are often generally expressed as the four "Cs": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations (a local population is a group of bull trout that spawn within a particular stream or portion of a stream system). The recovery planning process for bull trout (USFWS 2002a, pp. 49-50; 2004a, Vol 1 & 2 pp. 12-18; 2004b, pp. 60-86) has also identified the following conservation needs: 1) maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit, 2) preservation of the diversity of life-history strategies, 3) maintenance of genetic and phenotypic diversity across the range of each interim recovery unit, and 4) establishment of a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit (Rieman et al. 2003).

Central to the survival and recovery of bull trout is the maintenance of viable core areas (USFWS 2002a, pp. 53-54; 2004a, Vol. 1 pp. 210-218, Vol 2. pp. 61-62; 2004b, pp. 15-30, 64-67). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat. Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas recognized across the coterminous range of the bull trout (USFWS 2002a, pp. 6, 48, 98; 2004a, Vol. 1 p. vi, Vol. 2 pp. 14, 134; 2004b, pp. iv, 2; 2005, p. ii).

Jarbidge River Interim Recovery Unit

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawning adults, are estimated to occur in the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, incidental mortalities of released bull trout from recreational angling, historic angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004b). The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout within the core area, 2) maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area, 3) restore and maintain suitable habitat conditions for all life history stages and forms, and 4) conserve genetic diversity

and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning bull trout per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004b).

Klamath River Interim Recovery Unit

This interim recovery unit currently contains three core areas and seven local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002a). Bull trout populations in this interim recovery unit face a high risk of extirpation (USFWS 2002a). The draft Klamath River bull trout recovery plan (USFWS 2002a) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and strategies, 4) conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to 15 new local populations and an increase in population size from about 2,400 adults currently to 8,250 adults are needed to provide for the persistence and viability of the three core areas (USFWS 2002a).

Columbia River Interim Recovery Unit

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997, p. 1177). This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams (IDFGin litt., in litt. 1995). The draft Columbia River bull trout recovery plan (USFWS 2002c) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of the bull trout within core areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and 4) conserve genetic diversity and provide opportunities for genetic exchange.

This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good. All core areas have been subject to the combined effects of habitat degradation and fragmentation caused by the

following activities: dewatering; road construction and maintenance; mining; grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The Service completed a core area conservation assessment for the 5-year status review and determined that, of the 97 core areas in this interim recovery unit, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, 2 are at low risk, and 2 are at unknown risk (USFWS 2005, pp. 2, Map A, pp. 73-83).

Coastal-Puget Sound Interim Recovery Unit

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous[1], adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this interim recovery unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004a). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this interim recovery unit. Bull trout continue to be present in nearly all major watersheds where they likely occurred historically, although local extirpations have occurred throughout this interim recovery unit. Many remaining populations are isolated or fragmented and abundance has declined, especially in the southeastern portion of the interim recovery unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, poaching, incidental mortality from other targeted fisheries, and the introduction of non-native species. The draft Coastal-Puget Sound bull trout recovery plan (USFWS 2004a) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of bull trout within existing core areas, 2) increase bull trout abundance to about 16,500 adults across all core areas, and 3) maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River Interim Recovery Unit

This interim recovery unit currently contains six core areas and nine local populations (USFWS 2002b). Currently, bull trout are widely distributed in the St. Mary-Belly River drainage and occur in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (USFWS 2002b). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002b). The draft St. Mary-Belly River bull trout recovery plan (USFWS 2002b)

[1] Bull trout migrate from saltwater to freshwater to reproduce are commonly referred to as anadromous. However, bull trout and some other species that enter the marine environment are more properly termed amphidromous. Unlike strictly anadromous species, such as Pacific salmon, amphidromous species often return seasonally to fresh water as subadults, sometimes for several years, before returning to spawn (Brenkman and Corbett 2005, p. 1075; Wilson 1997, p. 5). Due to its more common usage, we will refer to bull trout has exhibiting anadromous rather than amphidromous life history patterns in this document.

identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and forms, 4) conserve genetic diversity and provide the opportunity for genetic exchange, and 5) establish good working relations with Canadian interests because local bull trout populations in this interim recovery unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, pp. 1-18) . Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989, p. 1; Goetz 1989, pp. 15-16). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, pp. 135-137; Goetz 1989, pp. 22-25), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978, pp. 139, 165-68; McPhail and Baxter 1996, p. 14; WDFW et al. 1997, pp. 17-18, 22-26). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, pp. 135-137; Leathe and Graham 1982, p. 95; Pratt 1992, p. 6; Rieman and McIntyre 1996, p. 133).

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989, pp. 29-32; Pratt 1984, p. 13) The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, p. 7). Habitat components that influence bull trout distribution and abundance

include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, pp. 137, 141; Goetz 1989, pp. 19-26; Bond in Hoelscher and Bjornn 1989, p. 57; Howell and Buchanan 1992, p. 1; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Rieman and McIntyre 1993, pp. 4-7; Rieman and McIntyre 1995, pp. 293-294; Sedell and Everest 1991, p. 1; Watson and Hillman 1997, pp. 246-250). Watson and Hillman (1997, pp. 247-249) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, p. 7), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997, p. 1560).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Gilpin, in litt. 1997, pp. 4-5; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1114). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993, p. 7; Spruell et al. 1999, pp. 118-120). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under "Diet."

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall (Fraley and Shepard 1989, p. 133; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Baxter et al. 1997, pp. 426-427; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1117). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C (35 °F to 39 °F) whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (46 °F to 50 °F) (Buchanan and Gregory 1997, pp. 121-122; Goetz 1989, pp. 22-24; McPhail and Murray 1979, pp. 41, 50, 53, 55). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C (46 °F to 48 °F), within a temperature gradient of 8 °C to 15 °C (4 °F to 60 °F). In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C (52 °F to 54 °F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997,

pp. 121-122; Fraley and Shepard 1989, pp. 135-137; Rieman and McIntyre 1993, p. 2; Rieman and McIntyre 1995, p. 288; Rieman et al. 1997, p. 1114). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8 °C to 20 °C (46 °F to 68 °F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Gamett, pers. comm. 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, pp. 135-137; Goetz 1989, pp. 22-25; Hoelscher and Bjornn 1989, p. 54; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Sedell and Everest 1991, p. 1; Sexauer and James 1997, pp. 367-369; Thomas 1992, pp. 4-5; Watson and Hillman 1997, pp. 247-249). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993, p. 7). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pp. 367-369). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, pp. 135-137; Pratt 1992, p. 6; Pratt and Huston 1993, pp. 70-72). Pratt (1992, p. 6) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989, p. 135). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, p. 15; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 8). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Ratliff and Howell 1992 in Howell and Buchanan 1992, pp. 10, 15; Pratt 1992, pp. 5-6).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). In a laboratory study conducted in Canada, researchers found that low oxygen levels retarded embryonic development in bull trout (Giles and Van der Zweep 1996, pp. 54-55). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables

that affect the survival of incubating embryos (ODEQ 1995). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Migratory forms of bull trout may develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes or nearshore marine habitat where foraging opportunities may be enhanced (Brenkman and Corbett 2005, pp. 1073, 1079-1080; Frissell 1993, p. 350; Goetz et al. 2004, pp. 45, 55, 60, 68, 77, 113-114, 123, 125-126). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999, pp. 15-16; MBTSG 1998, pp. iv, 48-50; Rieman and McIntyre 1993, pp. 18-19; USFWS 2004a, Vol. 2, p. 63). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger fish with higher fecundity is lost (Rieman and McIntyre 1993, pp. 1-18).

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, because this strategy can change as the fish progresses from one life stage to another (i.e., juvenile to subadult). Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994), and as fish grow, their foraging strategy changes as their food changes, in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, p. 58; Donald and Alger 1993, pp. 239-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout feed on various fish species (Brown 1994, p. 21; Donald and Alger 1993, p. 242; Fraley and Shepard 1989, p. 135; Leathe and Graham 1982, p. 95). Bull trout of all sizes other than fry have been found to eat fish up to half their length (Beauchamp and VanTassell 2001). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004, p. 114; WDFW et al. 1997, p. 23).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one source of food over another. For example, prey often occur in concentrated patches of abundance ("patch model") (Gerking 1994). As the predator feeds in one patch, the prey

population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005, p. 1079; Goetz et al. 2004, pp. 36, 60).

Changes in Status of the Coastal-Puget Sound Interim Recovery Unit

Although the status of bull trout in Coastal-Puget Sound interim recovery unit has been improved by certain actions, it continues to be degraded by other actions, and it is likely that the overall status of the bull trout in this population segment has not improved since its listing on November 1, 1999. Improvement has occurred largely through changes in fishing regulations and habitat-restoration projects. Fishing regulations enacted in 1994 either eliminated harvest of bull trout or restricted the amount of harvest allowed, and this likely has had a positive influence on the abundance of bull trout. Improvement in habitat has occurred following restoration projects intended to benefit either bull trout or salmon, although monitoring the effectiveness of these projects seldom occurs. On the other hand, the status of this population segment has been adversely affected by a number of Federal and non-Federal actions, some of which were addressed under section 7 of the Act. Most of these actions degraded the environmental baseline; all of those addressed through formal consultation under section 7 of the Act permitted the incidental take of bull trout.

Section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans (HCP) completed in the Coastal-Puget Sound population segment. These include: 1) the City of Seattle's Cedar River Watershed HCP, 2) Simpson Timber HCP (now Green Diamond Resources), 3) Tacoma Public Utilities Green River HCP, 4) Plum Creek Cascades HCP, 5) Washington State Department of Natural Resources (WSDNR) State Trust Lands HCP, 6) West Fork Timber HCP, and 7) WSDNR Forest Practices HCP. These HCPs provide landscape-scale conservation for fish, including bull trout. Many of the covered activities associated with these HCPs will contribute to conserving bull trout over the long-term; however, some covered activities will result in short-term degradation of the baseline. All HCPs permit the incidental take of bull trout.

Changes in Status of the Columbia River Interim Recovery Unit

The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of actions addressed under section 7 of the Act. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and all permitted or analyzed the potential for incidental take of bull trout. The Plum Creek Cascades HCP, Plum Creek Native Fish HCP, Storedahl Daybreak Mine HCP, and WSDNR Forest Practices HCP addressed portions of the Columbia River population segment of bull trout.

Changes in Status of the Klamath River Interim Recovery Unit

Improvements in the Threemile, Sun, and Long Creek local populations have occurred through efforts to remove or reduce competition and hybridization with non-native salmonids, changes in fishing regulations, and habitat-restoration projects. Population status in the remaining local populations (Boulder-Dixon, Deming, Brownsworth, and Leonard Creeks) remains relatively unchanged. Grazing within bull trout watersheds throughout the recovery unit has been curtailed. Efforts at removal of non-native species of salmonids appear to have stabilized the Threemile and positively influenced the Sun Creek local populations. The results of similar efforts in Long Creek are inconclusive. Mark and recapture studies of bull trout in Long Creek indicate a larger migratory component than previously expected.

Although the status of specific local populations has been slightly improved by recovery actions, the overall status of Klamath River bull trout continues to be depressed. Factors considered threats to bull trout in the Klamath Basin at the time of listing – habitat loss and degradation caused by reduced water quality, past and present land use management practices, water diversions, roads, and non-native fishes – continue to be threats today.

Changes in Status of the Saint Mary-Belly River Interim Recovery Unit

The overall status of bull trout in the Saint Mary-Belly River interim recovery unit has not changed appreciably since its listing on November 1, 1999. Extensive research efforts have been conducted since listing, to better quantify populations of bull trout and their movement patterns. Limited efforts in the way of active recovery actions have occurred. Habitat occurs mostly on Federal and Tribal lands (Glacier National Park and the Blackfeet Nation). Known problems due to instream flow depletion, entrainment, and fish passage barriers resulting from operations of the U.S. Bureau of Reclamation's Milk River Irrigation Project (which transfers Saint Mary-Belly River water to the Missouri River Basin) and similar projects downstream in Canada constitute the primary threats to bull trout and to date they have not been adequately addressed under section 7 of the Act. Plans to upgrade the aging irrigation delivery system are being pursued, which has potential to mitigate some of these concerns but also the potential to intensify dewatering. A major fire in August 2006 severely burned the forested habitat in Red Eagle and Divide Creeks, potentially affecting three of nine local populations and degrading the baseline.

LITERATURE CITED

Battin, J., M.W. Wiley, M.H. Ruckelshaus, R.N. Palmer, E. Korb, K.K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America 104(16):6720-6725.

Baxter, C.V. 2002. Fish movement and assemblage dynamics in a Pacific Northwest riverscape. Doctoral dissertation. Oregon State University, Corvallis, OR. 174 pp.

Baxter, J.S., E.B. Taylor, and R.H. Devlin. 1997. Evidence for natural hybridization between dolly varden (*Salvelinus malma*) and bull trout (*Salvelinus confluentus*) in a northcentral British Columbia watershed. Canadian Journal of Fisheries and Aquatic Sciences 54:421-429.

Beauchamp, D.A., and J.J. VanTassell. 2001. Modeling seasonal trophic interactions of adfluvial bull trout in Lake Billy Chinook, Oregon. Transactions of the American Fisheries Society 130:204-216.

Boag, T.D. 1987. Food habits of bull char (*Salvelinus confluentus*), and rainbow trout (*Salmo gairdneri*), coexisting in a foothills stream in northern Alberta. Canadian Field-Naturalist 101(1):56-62.

Bond, C.E. 1992. Notes on the nomenclature and distribution of the bull trout and the effects of human activity on the species. Pages 1-4 *In* P.J. Howell, and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain bull trout workshop, Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Bonneau, J.L., and D.L. Scarnecchia. 1996. Distribution of juvenile bull trout in a thermal gradient of a plunge pool in Granite Creek, Idaho. Transactions of the American Fisheries Society 125(4):628-630.

Brenkman, S.J., and S.C. Corbett. 2005. Extent of anadromy in bull trout and implications for conservation of a threatened species. North American Journal of Fisheries Management 25:1073-1081.

Brewin, P.A., and M.K. Brewin. 1997. Distribution maps for bull trout in Alberta. Pages 209-216 *In* W.C. Mackay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, Bull Trout Task Force (Alberta), c/o Trout Unlimited, Calgary.

Brown, L.G. 1994. The zoogeography and life history of Washington native charr. Washington Department of Fish and Widlife, Fisheries Management Division, Report # 94-04, Olympia, WA, November, 1992. 47 pp.

Buchanan, D.V., and S.V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. Pages 119-126 *In* W.C. Mackay, M.K. Brewing, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, , Alberta, Canada.

Cavender, T.M. 1978. Taxonomy and distribution of the bull trout, *Salvelinus confluentus* (Suckley), from the American Northwest. California Fish and Game 64(3):139-174.

Donald, D.B., and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology 71:238-247.

Dunham, J., B. Rieman, and G. Chandler. 2003. Influences of temperature and environmental variables on the distribution of bull trout within streams at the southern margin of its range. North American Journal of Fisheries Management 23:894-905.

Fraley, J.J., and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and river system, Montana. Northwest Science 63(4):133-143.

Frissell, C.A. 1993. Topology of extinction and endangerment of native fishes in the Pacific Northwest and California. Conservation Biology 7(2):342-354.

Frissell, C.A. 1999. An ecosystem approach to habitat conservation for bull trout: groundwater and surface water protection. Flathead Lake Biological Station, University of Montana, Open File Report Number 156-99, Polson, MT, January 07, 1999. 46 pp.

Gamett, B.L. 2002. Telephone conversation between Bart L. Gamett, Salmon-Challis National Forest, and Shelley Spalding, USFWS, re: relationship between water temperature and bull trout distribution and abundance in the Little Lost River, Idaho. June 20, 2002.

Gerking, S.D. 1994. Feeding ecology of fish. Academic Press, San Diego, California. 51 pp.

Giles, M.A., and M. Van der Zweep. 1996. Dissolved oxygen requirements for fish of the Peace, Athabasca and Slave River Basins: a laboratory study of bull trout *(Salveninus Confluentus)* and mountain whitefish *(Prosopium Williamsoni)*, Northern River Basins Study Technical Report No. 120 ed.

Gilpin, M. 1997. Memo to Shelly Spalding, Montana Department of Fish, Wildlife, and Parks. Connectivity on the Clark Fork River: The Bigger Picture. August 27, 1997.

Goetz, F. 1989. Biology of the bull trout, *Salvelinus confluentus*, a literature review. Willamette National Forest, Eugene, Oregon, February 1989. 53 pp.

Goetz, F., E.D. Jeanes, and E.M. Beamer. 2004. Bull trout in the nearshore. U.S. Army Corps of Engineers, Preliminary draft, Seattle, Washington, June 2004. 396 pp.

Hoelscher, B., and T.C. Bjornn. 1989. Habitat, density, and potential production of trout and char in Pend Oreille Lake tributaries. Idaho Department of Fish and Game, Project F-710R-10, Subproject III, Job No. 8., Boise, Idaho, January 1989. 60 pp.

Howell, P.J., and D.V. Buchanan. 1992. Proceedings of the Gearhart Mountain bull trout workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon. 67 pp.

IDFG (Idaho Department of Fish and Game). 1995. Fax from Bill Horton, IDFG, to Trish Klahr, UWFWS, Boise, Idaho, re: List of streams compiled by IDFG where bull trout have been extirpated.

Leary, R.F., and F.W. Allendorf. 1997. Genetic confirmation of sympatric bull trout and Dolly Varden in western Washington. Transactions of the American Fisheries Society 126:715-720.

Leathe, S.A., and P.J. Graham. 1982. Flathead Lake fish food habits study. US EPA, Region VIII, Water Division, Contract R008224-01-4, Denver, Colorado, October, 1982. 209 pp.

MBTSG. 1998. The relationship between land management activities and habitat requirements of bull trout. Montana Fish, Wildlife, and Parks, Helena, MT, May 1998. 77 pp.

McPhail, J.D., and J.S. Baxter. 1996. A review of bull trout (*Salvelinus confluentus*) life-history and habitat use in relation to compensation and improvement opportunities. Department of Zoology, University of British Columbia, Fisheries Management Report Number 104, Vancouver, BC. 31 pp.

McPhail, J.D., and C.B. Murray. 1979. The early life-history and ecology of dolly varden (*Salvelinus Malma*) in the upper Arrow Lakes. Department of Zoology and Institute of Animal Resource Ecology, Fort Steele, British Columbia. 113 pp.

Myrick, C.A., F.T. Barrow, J. Dunham, B.L. Gamett, G.R. Haas, J.T. Peterson, B. Rieman, L.A. Weber, and A.V. Zale. 2002. Bull trout temperature thresholds: peer review summary. U.S. Fish and Wildlife Service, Lacey, Washington, September 19, 2002. 13 pp.

ODEQ (Oregon Department of Environmental Quality). 1995. 1992-1994 water quality standards review: dissolved oxygen - final issue paper. Oregon Department of Environmental Quality, Portland, OR.

Pratt, K.L. 1984. Habitat use and species interactions of juvenile cutthroat, *Salmo clarki*, and bull trout, *Salvelinus confluentus*, in the upper Flathead River basin. Master's Thesis. University of Idaho, Moscow, ID.

Pratt, K.L. 1992. A review of bull trout life history. Pages 5-9 *In* P.J. Howell, and D.V. Buchanan, eds. Proceedings of the Gearhart Mountain bull trout workshop, Oregon Chapter of the American Fisheries Society, Corvallis, OR.

Pratt, K.L., and J.E. Huston. 1993. Status of bull trout (*Salvelinus confluentus*) in Lake Pend Oreille and the lower Clark Fork River. Washington Water Power Company, Spokane, WA, December 1993. 200 pp.

Quigley, T.M., and S.J. Arbelbide. 1997. An assessment of ecosystem components in the interior Columbia Basin and portions of the Klamath and Great Basins: Volume 3. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station 3:1174-1185.

Rich, C.F. 1996. Influence of abiotic and biotic factors on occurrence of resident bull trout in fragmented habitats, Western Montana. Master's Thesis. Montana State University, Bozeman, MT. 54 pp.

Rieman, B.E., D. Isaak, S. Adams, D. Horan, D. Nagel, C.H. Luce, and D. Myers. 2007. Anticipated climate warming effects on bull trout habitats and populations across the interior Columbia River Basin. Transactions of the American Fisheries Society 136(6):1552-1565.

Rieman, B.E., D. Lee, D. Burns, R.E. Gresswell, M.K. Young, R. Stowell, and P. Howell. 2003. Status of native fishes in western United States and issues for fire and fuels management. Forest Ecology and Management 178(1-2):197-211.

Rieman, B.E., D.C. Lee, and R.F. Thurow. 1997. Distribution, status, and likely future trends of bull trout within the Columbia River and Klamath River basins. North American Journal of Fisheries Management 7:1111-1125.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, General Technical Report INT-302, Ogden, Utah, September 1993. 38 pp.

Rieman, B.E., and J.D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124(3):285-296.

Rieman, B.E., and J.D. McIntyre. 1996. Spatial and temporal variability in bull trout redd counts. North American Journal of Fisheries Management 16:132-141.

Sedell, J.R., and F.H. Everest. 1991. Historic changes in pool habitat for Columbia River Basin salmon under study for TES listing. Pacific Northwest Research Station, Draft U.S. Department of Agriculture Report, Corvallis, Oregon. 6 pp.

Sexauer, H.M., and P.W. James. 1997. Microhabitat use by juvenile bull trout in four streams located in the eastern Cascades, Washington. Pages 361-370 *In* W.C. McKay, M.K. Brewin, and M. Monita, eds. Friends of the Bull Trout Conference Proceedings, Bull Trout Task Force (Alberta), c/o Trout Unlimited, Calgary, Alberta, Canada.

Simpson, J.C., and R.L. Wallace. 1982. Fishes of Idaho. University of Idaho Press, Moscow, ID. 93 pp.

Spruell, P., B.E. Rieman, K.L. Knudsen, F.M. Utter, and F.W. Allendorf. 1999. Genetic population structure within streams: microsatellite analysis of bull trout populations. Ecology of Freshwater Fish 8:114-121.

Stewart, D.B., N.J. Mochnacz, C.D. Sawatzky, T.J. Carmichael, and J.D. Reist. 2007. Fish life history and habitat use in the Northwest territories: Bull trout (*Salvelinus confluentus*). Department of Fisheries and Oceans, Canadian Manuscript Report of Fisheries and Aquatic Sciences 2801, Winnipeg, MB, Canada, 2007. 54 pp.

Thomas, G. 1992. Status of bull trout in Montana. Montana Department of Fish, Wildlife and Parks, Helena, MT, August 1992. 83 pp.

USFWS. 2002a. Bull trout (*Salvelinus confluentus*) draft recovery plan - Chapter 2: Klamath River. U.S. Fish and Wildlife Service, Portland, Oregon. 82 pp.

USFWS. 2002b. Bull trout (*Salvelinus confluentus*) draft recovery plan - Chapter 25: Saint Mary-Belly River. U.S. Fish and Wildlife Service, Portland, Oregon. 134 pp.

USFWS. 2002c. Chapter 20 of the bull trout *(Salvelinus confluentus)* draft recovery plan: Lower Columbia Recovery Unit, Washington. USFWS, Region 1, Portland, Oregon. 102 pp.

USFWS. 2004a. Draft Recovery Plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I: Puget Sound Management Unit, 389+xvii pp and Volume II: Olympic Peninsula Management Unit, 277+xvi pp, Portland, Oregon.

USFWS. 2004b. Draft recovery plan for the Jarbridge River distinct population segment of the bull trout (*Salvelinus confluentus*). U.S. Fish and Wildlife Service, Portland, Oregon, May 2004. 132 pp.

USFWS. 2005. Bull trout core area template - complete core area by core area analysis. U.S. Fish and Wildlife Service, Portland, Oregon. 662 pp.

Watson, G., and T.W. Hillman. 1997. Factors affecting the distribution and abundance of bull trout: an investigation at hierarchical scales. North American Journal of Fisheries Management 17(2):237-252.

WDFW, FishPro Inc., and Beak Consultants. 1997. Grandy Creek trout hatchery biological assessment. Washington Department of Fish and Wildlife, Olympia, WA, March 1997. 47 pp.

WDOE. 2002. Evaluating criteria for the protection of freshwater aquatic life in Washington's surface water quality standards - dissolved oyxgen: Draft discussion paper and literature summary. Washington Department of Ecology, Publication Number 00-10-071, Olympia, WA, December 2002.
90 pp.

Wilson, M.F. 1997. Variation in salmonid life histories: patterns and perspectives. U.S. Department of Agriculture, Research Paper PNW-RP-498, Portland, Oregon, February 1997. 50 pp.

APPENDIX C: STATUS OF THE SPECIES – BULL TROUT CRITICAL HABITAT

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Appendix C
STATUS OF BULL TROUT CRITICAL HABITAT (Rangewide)

Legal Status

Current Designation

The U.S. Fish and Wildlife Service (Service) published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule becomes effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, including six draft recovery units [Mid-Columbia, Saint Mary, Columbia Headwaters, Coastal, Klamath, and Upper Snake (75 FR 63927)]. The Service's 1999 coterminous listing rule identified five interim recovery units (50 CFR Part 17, pg. 58910), which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Our five year review recommended re-evaluation of these units based on new ()information (USFWS 2008, p. 9). However, until the bull trout draft recovery plan is finalized, the current five interim recovery units will be used for purposes of section 7 jeopardy analyses and recovery planning. The adverse modification analysis in this biological opinion does not rely on recovery units, relying instead on the newly listed critical habitat units and subunits.

Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table 1. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir/Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	19,729.0	31,750.8	488,251.7	197,589.2

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

This rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. See Tables 2 and 3 for the list of excluded areas. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

Table 2.—Stream/shoreline distance excluded from bull trout critical habitat based on tribal ownership or other plan.

Ownership and/or Plan	**Kilometers**	**Miles**
Lewis River Hydro Conservation Easements	7.0	4.3
DOD – Dabob Bay Naval	23.9	14.8
HCP – Cedar River (City of Seattle)	25.8	16.0
HCP – Washington Forest Practices Lands	1,608.30	999.4
HCP – Green Diamond (Simpson)	104.2	64.7
HCP – Plum Creek Central Cascades (WA)	15.8	9.8
HCP – Plum Creek Native Fish (MT)	181.6	112.8
HCP–Stimson	7.7	4.8
HCP – WDNR Lands	230.9	149.5
Tribal – Blackfeet	82.1	51.0
Tribal – Hoh	4.0	2.5
Tribal – Jamestown S’Klallam	2.0	1.2
Tribal – Lower Elwha	4.6	2.8
Tribal – Lummi	56.7	35.3

Ownership and/or Plan	Kilometers	Miles
Tribal – Muckleshoot	9.3	5.8
Tribal – Nooksack	8.3	5.1
Tribal – Puyallup	33.0	20.5
Tribal – Quileute	4.0	2.5
Tribal – Quinault	153.7	95.5
Tribal – Skokomish	26.2	16.3
Tribal – Stillaguamish	1.8	1.1
Tribal – Swinomish	45.2	28.1
Tribal – Tulalip	27.8	17.3
Tribal – Umatilla	62.6	38.9
Tribal – Warm Springs	260.5	161.9
Tribal – Yakama	107.9	67.1
Total	3,094.9	1,923.1

Table 3. Lake/Reservoir area excluded from bull trout critical habitat based on tribal ownership or other plan.

Ownership and/or Plan	Hectares	Acres
HCP – Cedar River (City of Seattle)	796.5	1,968.2
HCP – Washington Forest Practices Lands	5,689.1	14,058.1
HCP – Plum Creek Native Fish	32.2	79.7
Tribal – Blackfeet	886.1	2,189.5
Tribal – Warm Springs	445.3	1,100.4
Total	7,849.3	19,395.8

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the revised rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support core areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; Rieman and McIntyre 1993, p. 23; Rieman and Allendorf 2001, p. 763; MBTSG 1998, pp. 13-16).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of anadromous[1] bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult foraging, overwintering, and migration.

Primary Constituent Elements for Bull Trout

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the following PCEs are essential for the conservation of bull trout.

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

[1] Bull trout migrate from saltwater to freshwater to reproduce are commonly referred to as anadromous. However, bull trout and some other species that enter the marine environment are more properly termed amphidromous. Unlike strictly anadromous species, such as Pacific salmon, amphidromous species often return seasonally to fresh water as subadults, sometimes for several years, before returning to spawn (Brenkman and Corbett 2005, p. 1075; Wilson 1997, p. 5). Due to its more common usage, we will refer to bull trout has exhibiting anadromous rather than amphidromous life history patterns in this document.

4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

5. Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of

1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean lower low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to “destroy or adversely modify” critical habitat by no longer serving the intended conservation role for the species or retaining those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943; USFWS 2004, Vol. 1. pp. 140-193, Vol. 2, pp. 69-114). The Service’s evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998, pp. 4-39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

Current Critical Habitat Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Consulted on Effects for Critical Habitat

The Service has formally consulted on the effects to bull trout critical habitat throughout its range. Section 7 consultations include actions that continue to degrade the environmental baseline in many cases. However, long-term restoration efforts have also been implemented that provide some improvement in the existing functions within some of the critical habitat units.

LITERATURE CITED

Brenkman, S.J., and S.C. Corbett. 2005. Extent of anadromy in bull trout and implications for conservation of a threatened species. North American Journal of Fisheries Management 25:1073-1081.

Dunham, J., and B.E. Rieman. 1999. Metapopulation structure of bull trout: influence of physical, biotic, and geometrical landscape characteristics. Ecological Applications 9(2):642-655.

Fraley, J.J., and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and river system, Montana. Northwest Science 63(4):133-143.

Hard, J. 1995. A quantitative genetic perspective on the conservation of intraspecific diversity. American Fisheries Society Symposium 17:304-326.

Healey, M.C., and A. Prince. 1995. Scales of variation in life history tactics of Pacific salmon and the conservation of phenotype and genotype. American Fisheries Society Symposium 17:176-184.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River drainages. Conservation Biology 7(4):856-865.

Rieman, B.E., and F.W. Allendorf. 2001. Effective population size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-764.

Rieman, B.E., and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. U.S. Department of Agriculture, Forest Service, Intermountain Research Station, General Technical Report INT-302, Ogden, Utah, September 1993. 38 pp.

Rieman, B.E., J.T. Peterson, and D.E. Myers. 2006. Have brook trout (*Salvelinus fontinalis*) displaced bull trout (*Salvelinus confluentus*) along longitudinal gradients in central Idaho streams? Canadian Journal of Fish and Aquatic Sciences 63:63-78.

The Montana Bull Trout Scientific Group (MBTSG). 1998. The relationship between land management activities and habitat requirements of bull trout. Montana Fish, Wildlife, and Parks, Helena, MT, May 1998. 77 pp.

USFWS. 2004. Draft Recovery Plan for the Coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I: Puget Sound Management Unit, 389+xvii pp and Volume II: Olympic Peninsula Management Unit, 277+xvi pp, Portland, Oregon.

USFWS. 2008. Bull trout (*Salvelinus confluentus*) 5 year review: summary and evaluation. U.S. Department of Fish and Wildlife Service, Portland, Oregon, April 25, 2008. 55 pp.

USFWS, and NMFS. 1998. Final endangered species consultation handbook: Procedures for conducting consultation and conference activities under section 7 of the Endangered Species Act. U. S. Fish and Wildlife Service and National Marine Fisheries Service, U.S. GPO: 2004-690-278, Washington, D.C., March 1998. 189 pp.

Wilson, M.F. 1997. Variation in salmonid life histories: patterns and perspectives. U.S. Department of Agriculture, Research Paper PNW-RP-498, Portland, Oregon, February 1997. 50 pp.