UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS No:
WCRO-2018-00153

September 11, 2020

Michelle Walker
Chief, Regulatory Branch
Department of the Army
P.O. Box 3755
Seattle, Washington 98124-3755

Re: Endangered Species Act Biological Opinion, Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Millennium Coal Export Terminal, Columbia River (5th Field HUC 1708000302), Cowlitz County, Washington (Corps No.: NWS-2010-1225)

Dear Ms. Walker:

Thank you for your letter of March 1, 2017, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the U.S. Army Corps of Engineers' (Corps) issuance of a permit to Millennium Bulk Terminal to expand and upgrade their terminal at the Port of Longview under the authority of sections 10 and 14 of the Rivers and Harbors Act (33 U.S.C. §§ 403, 408) and section 404 of the Clean Water Act (33 U.S.C. § 1344). In this document, NMFS's opinion concludes that the proposed action is not likely to adversely affect:

- Guadalupe fur seals (*Arctocephalus townsendi*);
- green turtles (*Chelonia mydas*);
- Loggerhead turtles (*Caretta caretta*);
- Olive ridley turtles (*Lepidochelys olivacea*);
- Western North Pacific gray whales (*Eschrichtius robustus*);
- North Pacific right whales (*Eubalaena japonica*);
- Southern Resident killer whales (*Orcinus orca*).

We also conclude that the proposed action is not likely to jeopardize the continued existence of:

- Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha);* Upper Willamette River (UWR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon;
- LCR coho salmon (*O. kisutch);*
- Columbia River chum salmon (*O. keta*);

- Snake River (SR) sockeye salmon (*O. nerka*)
- LCR steelhead, UWR steelhead, Middle Columbia River steelhead, UCR steelhead, Snake River Basin (SRB) steelhead (*O. mykiss);*
- Southern distinct population of eulachon (*Thaleichthys pacificus*) (hereafter referred to as eulachon);
- Southern distinct population of green sturgeon (*Acipenser medirostris*), (hereafter referred to as green sturgeon);
- Sei whales (*Balaenoptera borealis*);
- Blue whales (*B. musculus*);
- Fin whales (*B. physalus*);
- Humpback whales (*Megaptera novaeangliae*);
- Sperm whales (*Physeter macrocephalus*); or
- Leatherback sea turtles (*Dermochelys coriacea*).

or result in the destruction or adverse modification of their designated critical habitats.

As required by section 7 of the ESA, NMFS is providing an incidental take statement with the opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the Federal action agency must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action. This document includes the results of our analysis of the action's likely effects on EFH, and includes one conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. This conservation recommendation is identical to the ESA take statement's terms and conditions. Section 305(b)(4) (B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH conservation recommendations, the Federal action agency must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

Please contact Scott E. Anderson in the Washington Coast Lower Columbia Branch of the Oregon/Washington Coastal Office, at 360-753-5828 or Scott.Anderson@noaa.gov if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Danette Guy, U.S. Army Corps of Engineers
Glenn Grette, Grette and Associates

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation for the

Millennium Bulk Coal Export Terminal
Columbia River (5th Field HUC 1708000302), Cowlitz County, Oregon

NMFS Consultation Number: WCRO-2018-00153

Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	ESA Status	Is Action Likely to Adversely Affect Species?	Is the Action likely to Jeopardize Species?	Is the action likely to adversely affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Lower Columbia River Chinook salmon	T	Yes	No	Yes	No
Upper Willamette River Chinook salmon	T	Yes	No	Yes	No
Upper Columbia River spring-run Chinook salmon	E	Yes	No	Yes	No
Snake River spring/summer run Chinook salmon	T	Yes	No	Yes	No
Snake River fall-run Chinook salmon	T	Yes	No	Yes	No
Columbia River chum salmon	T	Yes	No	Yes	No
Lower Columbia River coho salmon	T	Yes	No	Yes	No
Snake River sockeye salmon	E	Yes	No	Yes	No
Lower Columbia River steelhead	T	Yes	No	Yes	No
Upper Willamette River steelhead	T	Yes	No	Yes	No
Middle Columbia River steelhead	T	Yes	No	Yes	No
Upper Columbia River steelhead	T	Yes	No	Yes	No
Snake River Basin steelhead	T	Yes	No	Yes	No
Southern green sturgeon	T	Yes	No	Yes	No
Eulachon	T	Yes	No	Yes	No
Southern Resident killer whale	E	No	NA	Proposed - No	No
Blue whale	E	Yes	No	NA	No
Fin whale	E	Yes	No	NA	No
Sei whale	E	Yes	NA	NA	No
Humpback whale Mexico DPS	T	Yes	No	Proposed - Yes	No
Humpback whale Central America DPS	E	Yes	No	Proposed - yes	No
Western North Pacific gray whale	E	No	NA	NA	No
Sperm whale	E	Yes	No	NA	No
North Pacific right whale	E	No	NA	NA	No
Green turtle	E	No	NA	NA	No
Leatherback turtle	E	Yes	No	No	No
Loggerhead turtle	E	No	NA	NA	No

Fishery Management Plan that Describes EFH in the Action Area	Would the action adversely affect EFH?	Are EFH conservation recommendations provided?
Pacific Coast Groundfish	Yes	Yes
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: September 11, 2020

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LIST OF ACRONYMS

A&P	Abundance and Productivity
BA	Biological Assessment
BMP	Best Management Practice
CET	Coal Export Terminal
CFR	Code of Federal Regulations
CHART	Critical Habitat Analytical Review Team
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
Corps	U.S. Army Corps of Engineers
CRC	Clean Rivers Cooperative
CRD	Columbia River Datum
C.I.	Confidence Interval
CV	Coefficient of Variance
dB	Decibel
DGN	Drift Gillnet
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FNC	Columbia River Federal Navigation Channel
FR	Federal Register
HUC	Hydraulic Unit Code
IC	Interior Columbia
IMO	International Maritime Organization
ITS	Incidental Take Statement
IWC	International Whaling Commission
LCR	Lower Columbia River
MBT	Millennium Bulk Terminal
MCR	Middle Columbia River
MMPA	Marine Mammal Protection Act
MFSA	Maritime Fire and Safety Association
MPG	Major Population Group
MSA	Magnuson Stevens Act
NMFS	National Marine Fisheries Service
NWR	Northwest Region
OC	Oregon Coast
ODFW	Oregon Department of Fish and Wildlife
OGV	Ocean Going Vessel that loads coal at the CET
OHW	Ordinary High Water
OSRO	Oil Spill Response Organization

PAH	Polycyclic Aromatic Hydrocarbons
PBR	Potential Biological Removal
PBF	Primary constituent element
PWSA	Ports and Waterways Safety Act
Re: 1μPa	Reference 1 MicroPascal
RM	River Mile
RMS	Root Mean Squared
RPM	Reasonable and prudent measure
SEL	Sound exposure level
SONCC	Southern Oregon Northern California Coasts
SPL	Peak Sound Pressure Level
SR	Snake River
SRB	Snake River Basin
SS/D	Spatial Structure and Diversity
SWR	Southwest Region
TRT	Technical Review Team
UCR	Upper Columbia River
U.S.C.	United States Code
USCG	U.S. Coast Guard
UWR	Upper Willamette River
VSP	Viable Salmonid Population
WCR	West Coast Region
WDFW	Washington Department of Fish and Wildlife
WLC	Willamette/Lower Columbia

1. INTRODUCTION

This Introduction Section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological and conference opinion (opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, et seq.), and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, et seq.) and implementing regulations at 50 CFR 600.

We completed pre-dissemination review of the document using standards for utility, integrity, and objectivity in compliance with guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-55). A complete record of this consultation is on file at NOAA's Lacey, Washington Office, 510 Desmond Drive, Suite 103, Lacey, Washington 98503.

1.2 Consultation History

On March 1, 2017, NMFS received a biological assessment (BA) and a letter from the U.S. Army Corps of Engineers (Corps), requesting formal consultation pursuant to the ESA, and EFH consultation as required under the MSA, for the issuance of a permit under sections 10 and 14 ("Section 408") of the Rivers and Harbors Act and Section 404 of the Clean Water Act (CWA). The applicant, Millennium Bulk Terminals – Longview, LLC (MBT-Longview), is seeking permits for the construction of a Coal Export Terminal (CET). The CET project consists of rail and coal handling facilities in the upland portion of the site. Work within the Columbia River would include construction of two docks (referred to as "Docks 2 and 3") and their associated trestle, as well as dredging for berthing and navigation.

In that letter, the Corps concluded that the proposed action is likely to adversely affect (LAA) Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon, LCR coho salmon (*O. kisutch*), Snake River Basin (SRB) sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), UWR steelhead, Middle Columbia River steelhead, Upper Columbia River (UCR) steelhead, Snake River Basin (SRB) steelhead, southern distinct population of eulachon (*Thaleichthys pacificus*) (hereafter referred to as eulachon) and designated critical habitat for all of these populations. The Corps also concluded that the proposed action is likely to adversely affect the southern distinct population of green sturgeon (*Acipenser medirostris*), (hereafter referred to as green sturgeon).

The Corps did not request consultation for marine mammals and sea turtles. Upon review of the project, NMFS determined that the proposed project may affect several species of marine mammals and sea turtles through actions that are a consequence with the use of the terminal. We discussed these findings with the Corps and included the following species in our analysis: Blue whales (*Balaenoptera musculus*), fin whales (*B. physalus*), humpback whales (*Megaptera novaeangliae*), sperm whales (*Physeter macrocephalus*), sei whales (*B. borealis*), and leatherback sea turtles (*Dermochelys coriacea*), Additional vessel traffic from coal transport resulting from the proposed action will result in ships striking these animals. Therefore, the proposed action may affect and is likely to adversely affect these species. We also determined the project is NLAA for Southern Resident killer whales (*Orcinus orca*), North Pacific right whales (*Eubalaena japonica*), Western North Pacific gray whales (*Eschrichtius robustus*), Guadalupe fur seals (*Arctocephalus townsendi*), green turtles (*Chelonia mydas*), loggerhead turtles (*Caretta caretta*), and olive ridley turtles (*Lepidochelys olivacea*).

Site visits to the proposed terminal site occurred on July 12, 2017 and a meeting was held with the Port of Longview on June 15, 2017.

In September, 2017, the Washington State Department of Ecology (Ecology) denied CWA section 401 certification for the proposed action.

On October 27, 2017, we requested more information form the Corps on coal dust and stormwater.

On June 25, 2018, the project was withdrawn do to inactivity and lack of information.

On September 5, 2018, the Corps provided information responsive to our October 27 request.

On October 19, 2018, we requested further information regarding detailed toxicity effects from coal dust and coal contact water on ESA-listed species.

On March 13, 2019, we received the requested information and initiated consultation.

On December 4, 2019, NMFS contacted the Corps by email to ascertain their desire to include a conference opinion on proposed critical habitat for humpback whales and southern resident killer whales (SRKW). On December 5, 2019 the Corps, by email, indicated that a conference opinion was desirable.

The CET facility has been subject to ongoing litigation at the state and federal level.

This opinion is based on information provided in the January 13, 2017 BA, along with further information supplied on dates listed above.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on October 28, 2019 [84 FR 44976]. This consultation was pending at that time, and we are applying the updated regulations to the consultation. As the preamble to the final rule adopting the regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamlines consultations, and codifies existing practice." We have reviewed the information and analyses relied upon to complete this biological opinion in light of the updated regulations and conclude the opinion is fully consistent with the updated regulations.

A complete record of this consultation is on file in Lacey, Washington.

1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). We considered whether or not the proposed action would cause any other activities and determined that it would cause additional activities, as a new terminal is intended to support new vessel traffic to and from its location.

The COE proposes to issue a permit to the applicant, Millennium Bulk Terminals – Longview, LLC (MBT-Longview), under Section 10 and 14 of the Rivers and Harbors Act (33 USC 403 and 408) and section 404 of the Clean Water Act (33 USC 1344), for the construction and operation of a Coal Export Terminal (CET). The applicant also proposes construction of a mitigation site. We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would cause the following two activities. The first activity is the transport of coal by rail to the CET and coal handling at the CET. Trains will carry up to 44 million metric tons of coal through the state of Washington on an annual basis. The completed CET would add significant rail traffic along the shores of the Columbia River that would not be there otherwise. The second activity is vessel traffic, from OGVs traveling to and from the CET. The action would result in the addition of 840 OGVs transiting the lower Columbia River annually that would otherwise not be present without the CET.

With respect to EFH consultations, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

Project Overview

Millennium Bulk Terminals-Longview proposes to construct a CET at its existing facility in Longview, Washington along the Columbia River at River Mile (RM) 63 (Figure 1). The project will include the construction of two docks (Docks 2 and 3) and an associated trestle, and will dredge a berthing and navigation area for ships to access the new terminal. The upland portion of the CET site is an existing brownfield site suitably zoned for heavy industrial use. The Project would cover approximately 190 upland acres of the approximately 540-acre site. A separate portion of the site is, and would continue to be, used by MBT-Longview for bulk product handling operations, including the existing Dock 1 facility. The Corps issued a permit for a 10-year maintenance dredging program at Dock 1 in 2016 (NWS 2015-324) and a Corps permit for dock maintenance at Dock 1 is pending (NWS 2015-325). The Dock 1 dredging and dock maintenance actions are independent from the CET Project.

Figure 1. Coal Export Terminal project location on the Lower Columbia River.

Figure 2. Project location within the MBT-Longview industrial area.

Docks 2 and 3 and Associated Trestle

Docks 2 and 3 will each accommodate a Panamax-class bulk carrier. An overwater trestle will span between the upland portion of the terminal area and Dock 2, along which coal would be delivered to the shiploaders on Docks 2 and 3 via conveyors.

The CET Project will be developed in two stages. In Stage 1, MBT-Longview will construct Docks 2 and 3 and the associated trestle, install one shiploader and related conveyors on Dock 2, and deepen the berthing/navigation area. In Stage 2, MBT-Longview will install one shiploader and related conveyors on Dock 3. All in-water work will occur during Stage 1. Therefore, Stage 2 construction will entail no additional impact on aquatic habitat.

Millennium designed the project to minimize or avoid impacts to water shallower than -20 feet CRD based on their perspective that shallow water areas provide inherently higher biological function than deeper water. The only CET Project element to occur within water shallower than -20 ft CRD (inclusive of the active channel margin (ACM) and Shallow Water habitat categories) will be the approach trestle; Docks 2 and 3 and the berthing/navigation basin have all been located Deep Water habitat waterward of -20 ft CRD

The approach trestle will extend approximately 850 feet from shore, at a slight angle off of perpendicular from shore, to join Dock 2. From shore, the trestle will measure 24 ft in width for 700 ft, and 51 ft in width for the final 150 feet. The top of the deck will be at +22 ft CRD and the bottom of the deck at +19.5 ft CRD. Therefore, the bottom of the deck will be over eight feet above OHW. The trestle will result in 0.21 acres of new overwater coverage in the ACM, 0.09 (1742 square feet[sf]) acre in Shallow Water, and 0.21 (11,325 sf) acre in Deep Water (Table 1).

The trestle will be supported by 40, 36-inch diameter steel pile distributed amongst 14 two-pile bents (nine in the ACM, two in Shallow Water, and three in Deep Water) and four three-pile bents (all in Deep Water). All bents will be spaced at 40-foot intervals. Pile will be spaced on 20-foot centers along each bent. Trestle pile will result in the displacement of benthic habitat to the extent of 0.00 acre (127 sf) in the shallow nearshore, 0.00 acre (57 sf) in Shallow Water, and 0.00 acre (99 sf) in Deep Water.

Docks 2 and 3 will be located completely within Deep W habitat (below -20 ft CRD). The docks will be oriented parallel to shore and together be approximately 2,060 feet in length by 90 feet in width, except where Dock 2 joins the trestle and is slightly wider (127 ft in width). The top of the deck will be at +22 ft CRD and the bottom of the deck between +17.5 and +18 ft CRD. Therefore, the bottom of the deck will be approximately six to seven feet above OHW. Docks 2 and 3 will result in 4.32 acres of new overwater coverage (Table 1).

Docks 2 and 3 will be supported by approximately 491, 36-inch diameter steel piles. Piles will be distributed along two rows at 15-foot spacing and along three rows at 30-ft spacing. Rows will be spaced from 17.5 feet to 20 feet. The installation of the piles below the OHWL will displace approximately 0.08 acres (3,471 square feet) of benthic habitat, all of which would be in Deep Water (Table 1).

All of the 36-inch piles will be installed with a vibratory hammer and an impact hammer. According to the applicant, two pile drivers may operate simultaneously with up to a maximum of 50,000 strikes per day may occur during impact pile driving. Impact pile driving will occur over two construction seasons, between September 1 and December 31 in each season. The applicant will use a bubble curtain or similar device for noise attenuation whenever an impact hammer is used to drive piles.

All piles, mooring buoys, and navigational aids will be fitted with devices to prevent perching by piscivorous birds. In and over-water work will occur during the activity-specific work windows, described in Table 2.

Table 1. Permanent CET Project structure waterward of OHW.

	Shallow Nearshore (ACM[1]) Above -20 ft CRD	Shallow Nearshore (ACM[1]) Above -20 ft CRD	Shallow Water Above -20 ft CRD	Shallow Water Above -20 ft CRD	Below -20 ft CRD Deep Water	Below -20 ft CRD Deep Water	Total
Project Element	Trestle	Docks 2 and 3	Trestle	Docks 2 and 3	Trestle	Docks 2 and 3	Docks 2 and 3 and the Trestle
Pile (36-inch), count	18	N/A	8	N/A	14	491	up to 531
Pile, area	0.00 ac (127 ft^2)	--	0.00 ac (57 ft^2)	--	0.00 ac (99 ft^2)	0.08 ac (3,471 ft^2)	0.09 ac (3,754 ft^2)
Overwater coverage, area	0.21 ac	N/A	0.09 ac	N/A	0.21 ac	4.32 ac	4.83 ac

[1] Aquatic habitat categories used in this Plan are described in Section 3.3. The ACM or "Active Channel Margin" includes that portion of the river's edge that is located at the interface of the unwetted shoreline and shallow water, and occurs from OHW (+11.1 ft CRD) to 0 ft CRD.

Table 2. Activity specific work windows proposed for the CET Project, permitted work period in green

Construction Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Vibratory Pile Driving (in water)		2/28							9/1			
Impact Pile Driving (in water, associated trestle pile in upland areas*)									9/1			12/31
Dredging (mechanical and hydraulic)								8/1				12/31
Disposal at Ross Island								8/1				12/31
In-Water Dredge Disposal								8/1				12/31

* 19 trestle pile would be driven waterward of but near to OHW. Although installation of the 19 upland trestle pile would not be subject to in-water work restrictions, MBT-Longview proposes to install them during the same period as the in-water pile.

Dredge Cut for Berthing and Navigation

Initial dredging of an area larger than the berthing area is needed to prevent fall-back and to reduce annual dredging needs. Approximately 350,000 cubic yards of material from within a 41.5 acre dredge prism will be removed during initial dredging. Dredging will permanently deepen a 41.5-acre area, all of which is in water deeper than -20 ft CRD, to a target depth of -43 ft CRD with a two-foot overdredge allowance. The deepening required to reach target depth will vary from as little as a few feet up to approximately 16 feet. The side slopes of the dredge cut are projected to be sloped at 3h (horizontal) to 1v (vertical).

Dredging and Disposal

Dredged material from the initial dredge will be disposed of at the Ross Island Sand and Gravel lagoon in Portland, Oregon. The Ross Island lagoon is a state and federally authorized disposal site with an existing Corps permit and ESA Section 7 consultations (WCR-2016-5734, NWR-2000-468, WR-2007-158). The Oregon Department of Environmental Quality has reviewed the sediment characterization results for the CET and approved the material for disposal at Ross Island.

Dredging will be conducted using a barge-mounted mechanical clamshell dredge with material loaded into a bottom-dump barge for transport to the in-water disposal site once the barge is full. This method does not require dewatering. Initial dredging and disposal may require approximately two seasons, and will occur between August 1 and December 31.

Maintenance Dredging

Hydrodynamic modeling and sediment transport analysis for the Docks 2 and 3 berthing/navigation basin have determined that the area to be deepened is acted upon by strong river flow and a variable sediment budget. Sediment accretion in the Project area is governed by current velocity in the river and bedload transport from upstream sources. Strong down-current flow through the dredge prism is evident by erosional scour marks along the dredge cut for Dock 1 and the presence of dynamically-stable bed forms (i.e., sand waves) in the Project area.

Based on sediment accretion rates measured in the berth at Dock 1, it is expected that accretion in the Docks 2 and 3 berthing/navigation basin could represent an annual volume of between approximately 5,000 and 24,000 cubic yards. Maintenance dredging is therefore anticipated to occur on a multi-year basis, or as-needed following extreme-flow events.

The CET Project as proposed would include a 10-year maintenance dredge program for Docks 2 and 3 to dredge up to 100,000 cubic yards of infill as frequently as annually in order to maintain the depths authorized during deepening.

Based on sediment characterization completed for the new work material, it is expected that maintenance dredged material would be suitable for in-water disposal in the Columbia River. However, as a condition of the Suitability Determination (DMMO 2017), MBT – Longview will coordinate with the Dredged Material Management Program agencies to ensure that the Suitability Determination is still applicable for material removed during the maintenance dredging program. Material removed during maintenance dredging will be disposed of in-water in the Columbia River. Four potential flow lane disposal sites were identified and reviewed by the Portland District USACE during the Section 408 Agency Technical Review (ATR). These sites were chosen through a 3-tier screening process to locate potential areas that fit the criteria for open water disposal. These sites are found in table 3.

Table 3. In-water dredge disposal sites

Location (River Mile)	USACE Map ID[5]	Site ID	Area (acres)	Total Capacity (Volume in cubic yards)[6, 7]
40.7 to 41.3	CL_11	A	20.4	78,998
42.1 to 42.4	CL_11	D	9.0	34,706
71.5 to 71.8	CL_19	A	10.4	40,312
87.9 to 90.0	CL_24	A	81.8	316,669

Maintenance dredging would be conducted using a barge-mounted mechanical clamshell dredge with material loaded into a bottom-dump barge for in-water disposal. For in-water disposal, the operator would place the barge over the disposal area and open the bottom to release the material. Due to the draft of the barge, material would be released below the water surface.

Maintenance dredging is anticipated to occur on a multi-year basis, or as-needed following extreme-flow events, with areas and volumes considerably smaller than the initial dredge action. Maintenance dredging will occur between August 1 and December 31.

Mitigation

As part of the overall project, MBT-Longview also proposed compensatory mitigation for all permanent impacts to aquatic habitats. This includes compensation for new overwater coverage and habitat displacement from pile footprints resulting from construction of Docks 2 and 3 and associated trestle. All other temporary and short-term impacts related to dredging and construction activities are intended to be minimized through best management practices measures.

Proposed mitigation would entail the construction of an aquatic habitat mitigation site within the MBT-Longview lease area by converting an existing, isolated pond to an off-channel aquatic habitat connected to the Columbia River. The mitigation site is intended to provide habitat for important species (including all salmonid species affected by the CET Project) through restoration of a habitat type that was historically widespread but has since been vastly reduced throughout the lower Columbia River system. According to MBT-Longview, this mitigation is designed to address a key limiting factor as described in the Recovery Plan for salmon and steelhead in the lower Columbia River, off-channel habitats (LCFRB, 2010).

The Off-Channel Slough Mitigation Site would convert an isolated pond into an off-channel slough habitat complex with a surface connection to the Columbia River. The Site is currently located waterward of the Consolidated Diking Improvement District (CDID) levee, but is separated from the Columbia River by a berm. The site was previously used for placement of clean dredge material. Currently, the side has an existing pond fed by precipitation. The Site would provide approximately 7.0 acres of new off-channel slough habitat (below OHW; +11.1 ft CRD) and incorporate emergent and scrub-shrub wetland, and forested riparian habitat (Figure 5). The slough's elevation would range from a minimum of +4 ft CRD up to OHW to provide a range of habitat at varying river elevations and support a daily, year round surface connection to the Columbia River. The site would be intended to function as productive off-channel slough wetland and riparian complex, intended to benefit smaller subyearling salmonids as rearing and refuge habitat and larger yearling salmonids of all ESUs as a net-exporter of primary- and secondary-production.

Construction of the Off-Channel Slough Mitigation Site would first involve clearing and grubbing vegetation off of the outer berm using land-clearing equipment. Undesirable vegetation such as Himalayan blackberry and Scotch broom would be removed from the site. Existing trees along the outer toe of the berm would remain in place. Excavation of the berm would occur with land or barge-based equipment. Soil would be left in place at the eventual inlet channel to maintain isolation from the river until the completion of earthwork. Outside of the eventual inlet channel, no grading would occur on the riverward side of the berm. As mentioned above, the berm would be re-graded to a maximum elevation of +22 ft CRD, and the inner berm slope would be regraded to a stable slope as necessary. To the extent possible, excavation equipment would operate in the dry. Excavated material would be disposed of in the uplands or in a landfill.

Once the berm is reconstructed, the pond would be filled to appropriate elevations. The interior of the Site would be graded to include two riparian islands that extend to a maximum height of +8 ft to +10 ft CRD. The Site would be graded with a consistent slope down to the mouth to prevent fish stranding. Approximately 22,000 cy would be needed to elevate the pond to design elevations. Fill would be from a suitable upland source that meets all applicable in-water sediment standards.

Finally, the Site would be connected to the river by breaching the berm in the downstream extent of the site. It is anticipated that much of this will be removed prior to breaching and used to fill the pond, while leaving sufficient volume to prevent the river from entering the Site until breaching. Beaching is expected to occur using land-based excavators operating from the berm or the beach. After breaching, the Site would be planted with native emergent, shrub, and tree vegetation. Soil amendments would be placed as needed based on the nature of the soil. In particular, if berm soil includes a high sand and low organic content, soil amendments would likely be necessary to establish desirable vegetation.

Figure 3. Location of the Off-Channel Slough Mitigation Site on the Project site.

Figure 4. Proposed Off-Channel Slough Mitigation Site actions and habitat categories.

Site Water Management

Surface water quality and management for MBT-Longview's the entire leased area is governed by an existing National Pollution Discharge Elimination System (NPDES) permit (# WA-00008-6) which includes a stormwater prevent pollution plan. The construction and operation of the CET Project will alter the existing on-site water management system covered by the existing NPDES permit. MBT-Longview intends to maintain the existing NPDES permit for discharges from areas of its continued, present day operations and to obtain a new, separate NPDES permit for discharges originating from the CET Project area.

The site includes an internal network of ditches that collect and convey stormwater to three active outfalls. Two of these outfalls drain stormwater from limited areas along the north side of the site directly to the CDID ditch system; one outfall (002A) discharges treated water to the Columbia River. Surface water runoff collected in the network of onsite conveyance ditches is directed to the Industrial Wastewater Treatment Plant and then to the Sump/Pump Station where it is co-mingled with other process water and stormwater runoff from the site. All waters co-mingled at the Sump/Pump station are pumped through the treatment system at Facility 73 (including the retention basin and filter plant) prior to being discharged into the Columbia River.

The CET Project will develop a separate system of stormwater collection and discharge for the entire site footprint. No portion of the CET Project site will drain the CDID ditches. This CET Project collection and treatment system would discharge via an internal outfall which would then co-mingle with the MBT-Longview site storm, process and remediate waters and will be discharged through Outfall 002A, which is monitored in accordance with the existing NPDES permit. In addition to water treatment, the water management system would be designed to provide maximum opportunities for water reuse. During CET operations, water from washdown activities, rainfall runoff, and onsite wells will be used for coal dust suppression, washdown water, and fire protection systems. As a result, most runoff will be reused on site. No water will be withdrawn from the Columbia River or the CDID ditches.

During construction and operation, stormwater run-off from the upland portion of the site and from Docks 2 and 3 and the associated trestle will be captured and routed through these treatment systems (existing MBT-Longview system during construction, proposed CET Project system discharging to the MBT-Longview system during operations). Consistent with the existing treatment as well as the individual NPDES for the proposed Project, all effluent from the site would meet or exceed state and federal water quality guidelines/standards established under the NPDES permit prior to being discharged into the Columbia River.

Ballast Water

Vessels employing a Coast Guard approved ballast water management system must meet the following (USCG 2012):

- For organisms greater than or equal to 50 micrometers in minimum dimension, discharge must include fewer than 10 organisms per cubic meter of ballast water;

- For organisms less than 50 micrometers and greater than or equal to 10 micrometers, discharge must include fewer than 10 organisms per milliliter of ballast water;
- Toxicogenic *Vibrio cholerae* must be at a concentration of less than 1 colony forming unit (cfu) per 100 milliliter,
- *Escherichia coli* concentration must be fewer than 250 cfu per 100 milliliter, and
- Intestinal enterococci must have a concentration of fewer than 100 cfu per 100 milliliter.

NMFS found that the discharge of ballast water using the initial numerical standard is not likely to jeopardize the continued existence of endangered or threatened species in the Columbia River (and elsewhere) (NMFS 2012).

Shipping of Coal from Longview to the Pacific Ocean

The CET Project will accommodate new OGV traffic to ship coal down the Columbia River and through the Pacific Ocean. At full capacity, approximately 840 OGVs per year will be loaded at the CET. Based on data from the Merchants Exchange of Portland, Oregon, the number of cargo ship arrivals in the Columbia River for 2018 was 1,643 ships. The 840 OGVs per year is approximately a 59 percent increase in large vessel traffic leaving the Columbia River. The 59 percent increase does not represent the percent increase in all large vessels in the entire action area, which includes waters of the Pacific Ocean. (Figure 5, see also description of action area and Figure 6, below.) Data that show the number of large vessels in the action area are not available.

The OGVs that will be serviced at the CET will be a mix of Panamax (80 percent) and Handymax (20 percent) vessels. Panamax vessels are typically 965 feet long, 106 feet wide, and have a draft of 40 feet when full; Handymax vessels are somewhat smaller. Vessel speeds generally range from 9 to 15 knots in the Lower Columbia River, with the slower speeds in that range occurring while passing port areas; still slower speeds of between 6 and 9 knots occur while passing through anchorages (ICF et al, 2016). These OGVs are bulk carriers, which typically travel between 10 and 15 knots when traveling in the Pacific Ocean; the draft NEPA EIS for the CET project considers a vessel speed of 12 knots when illustrating shipping times (ICF 2016).

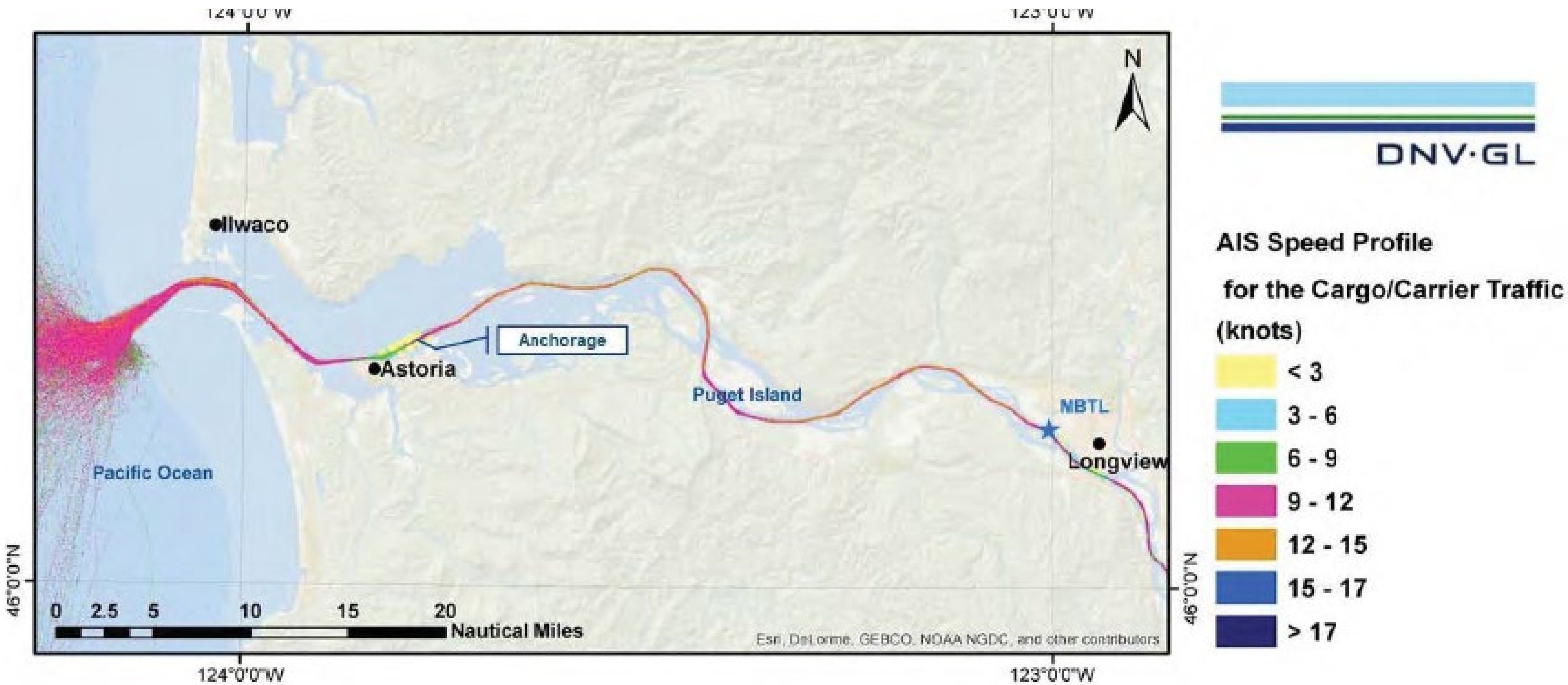

Figure 3-19 AIS Speed Profile for Cargo/Carrier Transits

Figure 5. Speed profile for cargo/carrier traffic in the Lower Columbia River and outside the mouth of the Columbia River (from the Vessel Transportation Technical Report, draft NEPA EIS, ICF 2016).

BMPs related to Construction, Dredging, Disposal, and Shiploading

General Construction BMPs

- Typical construction BMPs for working over, in, and near water would be applied, including checking equipment for leaks and other problems that could result in discharge of petroleum-based products, hydraulic fluid, or other material to the Columbia River.
- Contractors conducting in-water and over-water work, including demolition, will be familiar with implementation of BMPs and permit conditions typical of working in the aquatic environment.
- The contractor would have a spill containment kit, including oil-absorbent materials, on site to be used in the event of a spill or if any oil product is observed in the water.
- The contractor would be responsible for the preparation and implementation of a Spill Prevention, Control, and Countermeasures (SPCC) plan to be used for the duration of the project. The plan will be submitted to the Project engineer prior to the commencement of any Project activities. A copy of the plan with any updates will be maintained at the work site by the contractor.
- Equipment would have properly functioning mufflers, engine-intake silencers, and engine closures according to federal standards; the contractor will inspect fuel hoses, oil or fuel transfer valves, and fittings on a regular basis for drips or leaks in order to prevent spills into the surface water.
- Barges would not be allowed to ground out during construction.
- The contractor would use tarps or other containment methods when cutting, drilling, or performing over-water construction that might generate a discharge to prevent debris, sawdust, concrete and asphalt rubble, and other materials from entering the water.
- The contractor would be required to retrieve any floating debris generated during construction using a skiff and a net. Debris will be disposed of at an appropriate upland facility. If necessary, a floating boom will be installed to collect any floated debris generated during in-water operations.
- For work adjacent to water, proper erosion control measures would be installed prior to any clearing, grading, demolition, or construction activities to prevent the uncontrolled discharge of turbid water or sediments into waters of the state. Erosion control structures or devices would be regularly maintained and inspected to ensure their proper functioning throughout this project.
- No land-based construction equipment would enter any shoreline body of water except as authorized.
- All fuel and chemicals would be kept, stored, handled, and used in a fashion which assure no opportunity for entry of such fuel and chemicals into the water.

Pile Installation BMPs

- Vibratory pile driving would be used to the extent possible to minimize potential injurious or disturbing noise levels on fish species.
- During pile driving, a containment boom would be placed around the perimeter of the work area to capture wood debris and other materials released into the waters as a result of construction activities. All accumulated debris would be collected and disposed of

upland at an approved disposal site. Absorbent pads would be deployed should any sheen be observed.

- Impact driving during pile installation would be conducted using a confined bubble curtain or similar sound attenuation system capable of achieving approximately 7-9 dB of sound attenuation.

Dredging and Maintenance Dredging

- Operational controls would be implemented such as instructing the dredge operator to work in a controlled manner.
- The contractor is not allowed to stockpile dredged material on the river bottom surface.
- Initial dredged material would be contained within a barge prior to disposal at the Ross Island site. Dredged material would not be stockpiled on the river bed.
- The contractor would remove any floating oil, sheen, or debris within the work area as necessary to prevent loss of materials from the site. The Contractor would be responsible for retrieval of any floating oil, sheen, or debris from the work area and any damages resulting from the loss.
- For material being taken to in-water disposal sites, all debris (larger than 2 feet in any dimension) would be removed from the dredged sediment prior to disposal. Similar sized debris found floating in the dredging or disposal area would also be removed.
- Project construction would limit the impact of turbidity to a defined mixing zone and would otherwise comply with WAC 173-201A, which establishes a downstream extent of mixing zone at 300 feet.

Coal and Dust Management during Shiploading

Coal will be transferred onsite from the rail cars to the ships via a coal conveyance system. BMPs that will help manage coal and dust during shiploading include:

- Enclosed shiploader boom;
- Enclosed loading spout;
- Discharge of coal below deck of vessel;
- Cleanup and washdown by high pressure water; and
- Capture and containment of washdown water.

Coal conveyance system would be designed to minimize the release of coal dust, the trestle conveyor is enclosed. The conveyors have belt cleaning to control carry back. The dock is not enclosed, but is designed to contain all spillage and water, which is returned back to the water management system. The shiploader boom is enclosed to contain any spillage or hose-down clean-up work. The discharge of coal into the vessel is through an enclosed chute to allow discharge of the coal below the deck of the ship. The shiploader boom positions the chute in close proximity to the point of discharge. A spoon deflector allows the coal to be placed inside the hull below the deck of the vessel without additional handling.

1.4 Action Area

"Action area" means 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).

For the proposed action, the action area encompasses the CET facility (including Dock 2 and 3, associated trestle, dredging area, and mitigation site) and an area that begins upstream of the proposed CET facility at Columbia River RM 68, based on the extent of underwater sound during CET Project pile driving.

The action area also extends downstream through the Columbia River navigation channel and into the Pacific Ocean, where it expands into a fan shape as defined by OGV travel routes, until it reaches the continental shelf approximately 40 miles offshore. The northern border of this fan is N 46° 57′, W 125° 18′ and the southern border is approximately N 45° 01′, W 125° 18′ (Figure 3). Within this fan area, encounters, including vessel collisions and impact from ship noise, are reasonably certain to occur between OGVs and marine mammals and leatherback sea turtles. Although the OGVs that travel through this area are likely to continue on to Asia, their exact destinations and routes are not known at this time and the density of marine mammals and leatherback sea turtles is substantially lower beyond the continental shelf. Beyond this area in the Pacific Ocean, the risk of a ship strike with a marine mammal or sea turtle becomes unlikely. Therefore, this action area delimits the geographic location where the proposed action is likely to result in effects on listed species and critical habitat.

The action area includes aquatic habitats identified by the Pacific Fisheries Management Council as EFH for Pacific salmon (PFMC 2014), and groundfish (PFMC 2006; PFMC 2019).

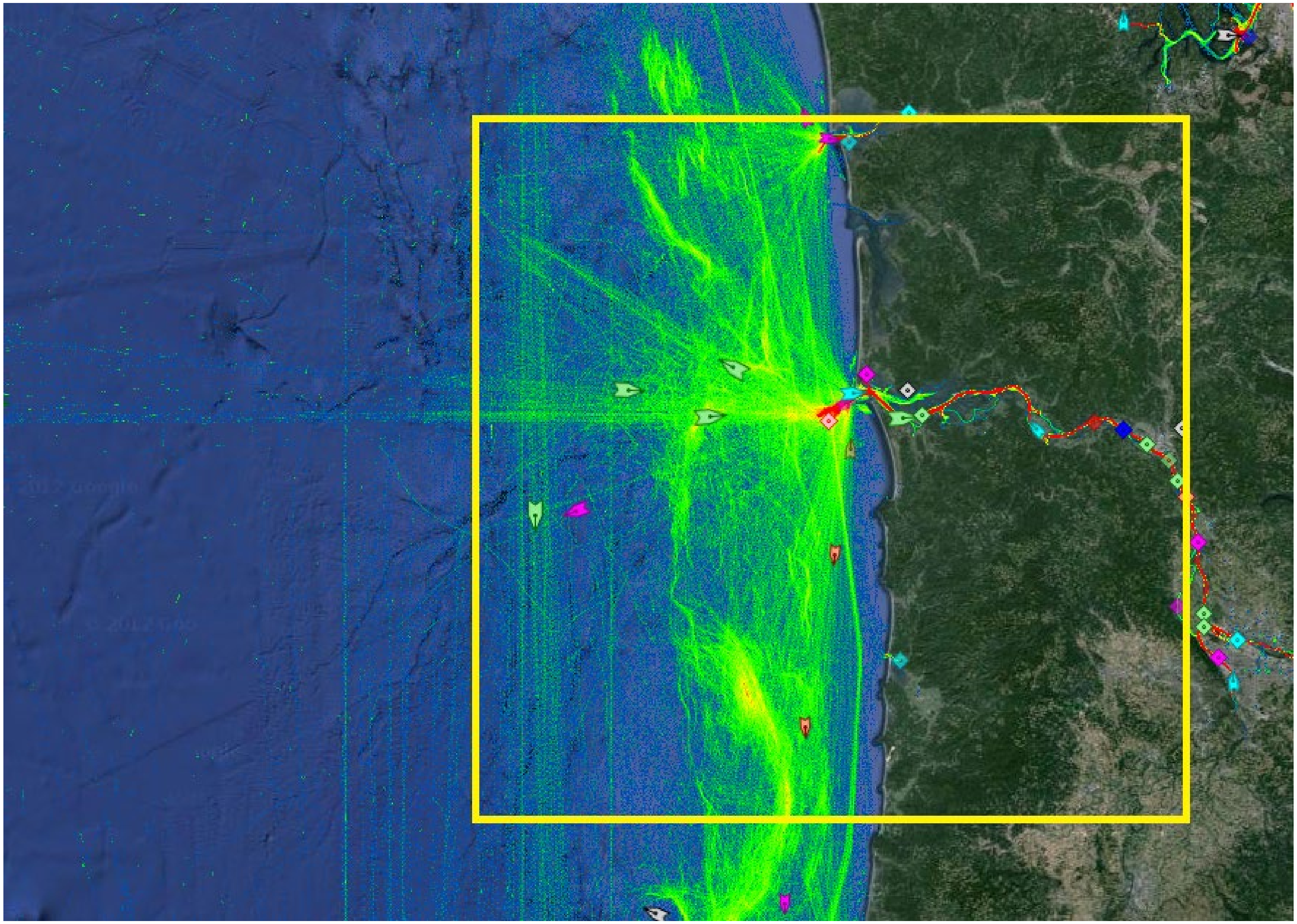

Figure 6. Action area for OGV traffic from CET and out through the Pacific Ocean (Data/Image from www.marinetraffic.com, last semester of 2013).

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION, CONFERENCE OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by Section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Approach to the Analysis

This biological opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of" a listed species, which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designations of critical habitat for certain Columbia River species use the term "primary constituent element" (PCE) or "essential features." The 2016 critical habitat regulations (50 CFR 424.12) replace these terms with "physical or biological features" (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether the proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote et al. 2014, Mote 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013, Mote et al. 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; [Abatzoglou et al. 2014; Kunkel et al. 2013]). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014). Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB

2007; Mote et al. 2013; Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Mantua et al. 2010; Isaak et al. 2012). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Winder and Schindler 2004, Raymondi et al. 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Wainwright and Weitkamp 2013; Raymondi et al. 2013). These temperature, oxygen and flow changes would also be expected to affect Eulachon and Green sturgeon as they enter freshwater to forage or spawn, although potential effects on these species from climate change is less understood.

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (McMahon and Hartman 1989; Lawson et al. 2004).

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7°C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011, Reeder et al. 2013).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. Acidification also impacts sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012, Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011, Reeder et al. 2013). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007).

Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011, Reeder et al. 2013).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these ESUs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

Climate change also affects the rangewide status of blue whales, fin whales, humpback whales, and sperm whales, and marine habitat at large. Some of the effects of climate change on the Pacific Ocean are discussed above. In addition, evidence suggests that the productivity in the North Pacific (Mackas et al. 1989; Quinn and Niebauer 1995) and other oceans could be affected by changes in the environment. Increases in global temperatures are expected to have profound impacts on arctic and sub-arctic ecosystems, and these impacts are projected to accelerate during this century (ACIA 2004; Anisimov et al. 2007). The potential impacts of climate and oceanographic change on large whales will likely affect habitat availability and food availability. Large whale migration, feeding, and breeding locations may be influenced by factors such as ocean currents and water temperature. Any changes in these factors could render currently used habitat areas unsuitable and promote use of previously unutilized or previously not existing habitats may be a necessity for displaced individuals. Changes to climate and oceanographic processes may also lead to decreased productivity in different patterns of prey distribution and availability. Such changes could affect large whales that are dependent on those affected prey. The feeding range of large whales is wide and consequently, it is likely that whales may be more resilient to climate change, should it affect prey, than a species with a narrower range.

Based upon available information, it is likely that leatherback sea turtles are being affected and will be further affected by climate change. Similar to other sea turtle species, leatherbacks are likely affected by rising temperatures that may affect nesting success and skew sex ratios, and rising sea surface temperatures that may affect available nesting beach areas as well as ocean productivity. Leatherbacks are known to travel within specific isotherms and these could be affected by climate change and cause changes in their migration and prey availability (Robinson et al. 2008). Unlike other sea turtle species which may be prey limited due to climate changes to their forage base, leatherbacks feed primarily on jellyfish and some species are expected to increase in abundance due to ocean warming (Brodeur et al. 1999; Attrill et al. 2007; Purcell et al. 2007; Richardson et al. 2009).

2.2.1 Status of the Species

Table 4, below provides a summary of listing and recovery plan information, status summaries and limiting factors for many of the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. These documents are available on the NMFS West Coast Region website (http://www.westcoast.fisheries.noaa.gov/). Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Multiple Population Grouping), NWFSC (Northwest Fisheries Science Center), TRT (Technical Recovery Team), and VSP (Viable Salmonid Population).

Table 4. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for fish species considered in this opinion

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River Chinook salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	This ESU comprises 32 independent populations. Twenty-seven populations are at very high risk, 2 populations are at high risk, one population is at moderate risk, and 2 populations are at very low risk Overall, there was little change since the last status review in the biological status of this ESU, although there are some positive trends. Increases in abundance were noted in about 70% of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline VSP levels identified in the recovery plan, there has been an overall improvement in the status of a number of fall-run populations, although most are still far from the recovery plan goals.	• Reduced access to spawning and rearing habitat • Hatchery-related effects • Harvest-related effects on fall Chinook salmon • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminants
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This ESU comprises four independent populations. Three are at high risk and one is functionally extirpated. Current estimates of natural origin spawner abundance increased relative to the levels observed in the prior review for all three extant populations, and productivities were higher for the Wenatchee and Entiat populations and unchanged for the Methow population. However, abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations.	• Effects related to hydropower system in the mainstem Columbia River • Degraded freshwater habitat • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Persistence of non-native (exotic) fish species • Harvest in Columbia River fisheries

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NWFSC 2015	This ESU comprises 28 extant and four extirpated populations. All expect one extant population (Chamberlin Creek) are at high risk. Natural origin abundance has increased over the levels reported in the prior review for most populations in this ESU, although the increases were not substantial enough to change viability ratings. Relatively high ocean survivals in recent years were a major factor in recent abundance patterns. While there have been improvements in abundance and productivity in several populations relative to prior reviews, those changes have not been sufficient to warrant a change in ESU status.	• Degraded freshwater habitat • Effects related to the hydropower system in the mainstem Columbia River, • Altered flows and degraded water quality • Harvest-related effects • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River Chinook salmon	Threatened 6/28/05	NMFS 2011	NWFSC 2015	This ESU comprises seven populations. Five populations are at very high risk, one population is at moderate risk (Clackamas River) and one population is at low risk (McKenzie River). Consideration of data collected since the last status review in 2010 indicates the fraction of hatchery origin fish in all populations remains high (even in Clackamas and McKenzie populations). The proportion of natural origin spawners improved in the North and South Santiam basins, but is still well below identified recovery goals. Abundance levels for five of the seven populations remain well below their recovery goals. Of these, the Calapooia River may be functionally extinct and the Molalla River remains critically low. Abundances in the North and South Santiam rivers have risen since the 2010 review, but still range only in the high hundreds of fish. The Clackamas and McKenzie populations have previously been viewed as natural population strongholds, but have both experienced declines in abundance despite having access to much of their historical spawning habitat. Overall, populations appear to be at either moderate or high risk, there has been likely little net change in the VSP score for the ESU since the last review, so the ESU remains at moderate risk.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats • Altered food web due to reduced inputs of microdetritus • Predation by native and non-native species, including hatchery fish • Competition related to introduced salmon and steelhead • Altered population traits due to fisheries and bycatch

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017ba	NWFSC 2015	This ESU has one extant population. Historically, large populations of fall Chinook salmon spawned in the Snake River upstream of the Hells Canyon Dam complex. The extant population is at moderate risk for both diversity and spatial structure and abundance and productivity. The overall viability rating for this population is 'viable.' Overall, the status of Snake River fall Chinook salmon has clearly improved compared to the time of listing and compared to prior status reviews. The single extant population in the ESU is currently meeting the criteria for a rating of 'viable' developed by the ICTRT, but the ESU as a whole is not meeting the recovery goals described in the recovery plan for the species, which require the single population to be "highly viable with high certainty" and/or will require reintroduction of a viable population above the Hells Canyon Dam complex.	• Degraded floodplain connectivity and function • Harvest-related effects • Loss of access to historical habitat above Hells Canyon and other Snake River dams • Impacts from mainstem Columbia River and Snake River hydropower systems • Hatchery-related effects • Degraded estuarine and nearshore habitat.
Columbia River chum salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Overall, the status of most chum salmon populations is unchanged from the baseline VSP scores estimated in the recovery plan. A total of 3 of 17 populations are at or near their recovery viability goals, although under the recovery plan scenario these populations have very low recovery goals of 0. The remaining populations generally require a higher level of viability and most require substantial improvements to reach their viability goals. Even with the improvements observed during the last five years, the majority of populations in this ESU remain at a high or very high risk category and considerable progress remains to be made to achieve the recovery goals.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Degraded stream flow as a result of hydropower and water supply operations • Reduced water quality • Current or potential predation • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Of the 24 populations that make up this ESU, 21 populations are at very high risk, 1 population is at high risk, and 2 populations are at moderate risk. Recent recovery efforts may have contributed to the observed natural production, but in the absence of longer term data sets it is not possible to parse out these effects. Populations with longer term data sets exhibit stable or slightly positive abundance trends. Some trap and haul programs appear to be operating at or near replacement, although other programs still are far from that threshold and require supplementation with additional hatchery-origin spawners .Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon populations, abundances are still at low levels and the majority of the populations remain at moderate or high risk. For the Lower Columbia River region land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. Although populations in this ESU have generally improved, especially in the 2013/14 and 2014/15 return years, recent poor ocean conditions suggest that population declines might occur in the upcoming return years	• Degraded estuarine and near-shore marine habitat • Fish passage barriers • Degraded freshwater habitat: Hatchery-related effects • Harvest-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015	NWFSC 2015	This single population ESU is at very high risk dues to small population size. There is high risk across all four basic risk measures. Although the captive brood program has been successful in providing substantial numbers of hatchery produced fish for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to re-establish sustainable natural production In terms of natural production, the Snake River Sockeye ESU remains at extremely high risk although there has been substantial progress on the first phase of the proposed recovery approach – developing a hatchery based program to amplify and conserve the stock to facilitate reintroductions.	• Effects related to the hydropower system in the mainstem Columbia River • Reduced water quality and elevated temperatures in the Salmon River • Water quantity • Predation
Upper Columbia River steelhead	Threatened 1/5/06	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This DPS comprises four independent populations. Three populations are at high risk of extinction while 1 population is at moderate risk. Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations. The status of the Wenatchee River steelhead population continued to improve based on the additional year's information available for the most recent review. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5% extinction risk. However, the overall DPS status remains unchanged from the prior review, remaining at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded floodplain connectivity and function, channel structure and complexity, riparian areas, large woody debris recruitment, stream flow, and water quality • Hatchery-related effects • Predation and competition • Harvest-related effects

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River steelhead	Threatened 1/5/06	NMFS 2013	NWFSC 2015	This DPS comprises 23 historical populations, 17 winter-run populations and six summer-run populations. Nine populations are at very high risk, 7 populations are at high risk, 6 populations are at moderate risk, and 1 population is at low risk. The majority of winter-run steelhead populations in this DPS continue to persist at low abundances. Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead populations were similarly stable, but at low abundance levels. The decline in the Wind River summer-run population is a source of concern, given that this population has been considered one of the healthiest of the summer-runs; however, the most recent abundance estimates suggest that the decline was a single year aberration. Passage programs in the Cowlitz and Lewis basins have the potential to provide considerable improvements in abundance and spatial structure, but have not produced self-sustaining populations to date. Even with modest improvements in the status of several winter-run DIPs, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Reduced access to spawning and rearing habitat • Avian and marine mammal predation • Hatchery-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011	NWFSC 2015	This DPS has four demographically independent populations. Three populations are at low risk and one population is at moderate risk. Declines in abundance noted in the last status review continued through the period from 2010-2015. While rates of decline appear moderate, the DPS continues to demonstrate the overall low abundance pattern that was of concern during the last status review. The causes of these declines are not well understood, although much accessible habitat is degraded and under continued development pressure. The elimination of winter-run hatchery release in the basin reduces hatchery threats, but non-native summer steelhead hatchery releases are still a concern for species diversity and a source of competition for the DPS. While the collective risk to the persistence of the DPS has not changed significantly in recent years, continued declines and potential negative impacts from climate change may cause increased risk in the near future.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats due to impaired passage at dams • Altered food web due to changes in inputs of microdetritus • Predation by native and non-native species, including hatchery fish and pinnipeds • Competition related to introduced salmon and steelhead • Altered population traits due to interbreeding with hatchery origin fish
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009b	NWFSC 2015	This DPS comprises 17 extant populations. The DPS does not currently include steelhead that are designated as part of an experimental population above the Pelton Round Butte Hydroelectric Project. Returns to the Yakima River basin and to the Umatilla and Walla Walla Rivers have been higher over the most recent brood cycle, while natural origin returns to the John Day River have decreased. There have been improvements in the viability ratings for some of the component populations, but the DPS is not currently meeting the viability criteria in the MCR steelhead recovery plan. In general, the majority of population level viability ratings remained unchanged from prior reviews for each major population group within the DPS.	• Degraded freshwater habitat • Mainstem Columbia River hydropower-related impacts • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Harvest-related effects • Effects of predation, competition, and disease

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River basin steelhead	Threatened 1/5/06	NMFS 2017a	NWFSC 2015	This DPS comprises 24 populations. Two populations are at high risk, 15 populations are rated as maintained, 3 populations are rated between high risk and maintained, 2 populations are at moderate risk, 1 population is viable, and 1 population is highly viable. Four out of the five MPGs are not meeting the specific objectives in the draft recovery plan based on the updated status information available for this review, and the status of many individual populations remains uncertain A great deal of uncertainty still remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites within individual populations.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded freshwater habitat • Increased water temperature • Harvest-related effects, particularly for B-run steelhead • Predation • Genetic diversity effects from out-of-population hatchery releases
Southern DPS of green sturgeon	Threatened 4/7/06	NMFS 2018	NMFS 2015c	The Sacramento River contains the only known green sturgeon spawning population in this DPS. The current estimate of spawning adult abundance is between 824-1,872 individuals. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays. Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon prefer marine waters of less than a depth of 110 meters.	• Reduction of its spawning area to a single known population • Lack of water quantity • Poor water quality • Poaching

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Southern DPS of eulachon	Threatened 3/18/10	NMFS 2017c	Gustafson et al. 2016	The Southern DPS of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Sub populations for this species include the Fraser River, Columbia River, British Columbia and the Klamath River. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River. Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings eventually declined to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013-2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest that population declines may be widespread in the upcoming return years	• Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success. • Climate-induced change to freshwater habitats • Bycatch of eulachon in commercial fisheries • Adverse effects related to dams and water diversions • Water quality, • Shoreline construction • Over harvest • Predation

In addition to the species found in table 4, above, several marine mammals and sea turtles may also be exposed to effects of the proposed action. The status of these species is presented here in narrative form.

Marine Mammals

Based on the known distribution of ESA-listed species (including surveys, and general life history and abundance), the following marine mammal species will be addressed in the analysis as part of our formal consultation: blue whale, fin whale, humpback whale, sei whales, and sperm whale. We found that the proposed action may affect but is not likely to adversely affect other species including, Guadalupe fur seals, Southern Resident killer whales, North Pacific right whales, Western North Pacific Gray whales, green sea turtles, loggerhead sea turtles, and olive ridley sea turtles. More detail on this determination can be found in section 2.11 of this document. Recovery plans are in place for all of the species considered in this analysis and they can be found at: http://www.nmfs.noaa.gov/pr/recovery/plans.htm#mammals.
Certain recovery plans are currently being updated (the blue whale recovery plan), so we provide more recent information in this opinion than what is currently available in the final recovery plan available at the above link.

NMFS recognizes geographic stocks of whales under the Marine Mammal Protection Act (MMPA)(section 117, 16 U.S.C. 1386)[1], and requires the monitoring and management of marine mammals on a stock-by-stock basis, rather than entire species, populations, or DPSs. Although the stock identification is not recognized as part of the ESA-listing, it does provide a meaningful framework for analyzing the impacts of the proposed action on whale populations as a whole.

Status of Blue Whales. The blue whale was listed as endangered worldwide under the precursor to the ESA, the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491; June 2, 1970). The entire species remains endangered under the ESA. There is no designated critical habitat for blue whales.

Spatial structure and diversity. The Eastern North Pacific Stock of blue whales includes animals found in the eastern north Pacific from the northern Gulf of Alaska to the eastern tropical Pacific (Carretta et al., 2017). Most blue whale sightings are in nearshore and continental shelf waters

[1] Section 117. Stock Assessments 16 U.S.C. 1386: Each draft stock assessment, based on the best scientific information available shall (1) Describe the geographic range of the affected stock, including any seasonal or temporal variation in such range; (2) provide for such stock the minimum population estimate, current and maximum net productivity rates, and current population trend, including a description of the information upon which these are based; (3) estimate the annual human-caused mortality and serious injury of the stock by source and, for a strategic stock, other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey; (4) describe commercial fisheries that interact with the stock, including the approximate number of vessels actively participating in each such fishery, the estimated level of incidental mortality and serious injury of the stock by each such fishery on an annual basis, seasonal or area differences in such incidental mortality or serious injury; and the rate, based on the appropriate standard unit of fishing effort, of such incidental mortality and serious injury, and an analysis stating whether such level is insignificant and is approaching a zero mortality and serious injury rate; (5) categorize the status of the stock as one that either has a level of human-caused mortality and serious injury that is not likely to cause the stock to be reduced below its optimum sustainable population, or is a strategic stock, with a description of the reasons therefor; and (6) estimate the potential biological removal level for the stock, describing the information used to calculate it, including the recovery factor.

but blue whales frequently migrate through deep oceanic waters to spend their summers feeding in productive waters near the higher latitudes of the Gulf of Alaska and the Aleutian Islands and their winters in the warmer waters at lower latitudes from Southern California to Costa Rica (Calambokidis and Barlow, 2013; Calambokidis et al., 2009b). None of the nine feeding areas for blue whales off the U.S. West Coast areas are within the Action Area (Calambokidis et al., 2015). There was one sighting of a blue whale (Oleson and Hildebrand, 2012) during 42 small boat surveys from Grays Harbor out to the 1,000 meter isobath off Quinault between 2004 and 2009. Aerial surveys conducted in waters off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012, encountered a total of 16 blue whales during the fall (Adams et al., 2014). Acoustic monitoring in waters off the coast of Washington show a yearly seasonal pattern of blue whale presence from summer through winter (Oleson and Hildebrand, 2012).

Abundance and productivity. The Eastern Pacific blue whale population may have reached a stable level at 97 percent of carrying capacity in 2013 following the cessation of commercial whaling in 1971 (Monnahan et al., 2015).

Limiting factors. In waters off California between 1991 and 2010 there were 14 ship strikes involving blue whales (Calambokidis, 2012; Calambokidis et al., 2009a; Monnahan et al., 2015) and 10 blue whales died from vessel strikes between 2007 and 2011 in waters of the U.S. West Coast (Carretta et al., 2017; Carretta et al., 2013). There was one blue whale ship strike death reported in 2016 (Carretta et al., 2017).

Status of Fin Whales. Fin whales were listed as endangered worldwide under the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 Fed. Reg. 8491) (June 2, 1970) (codified at 50 C.F.R. § 17.11(h)). There is no designated critical habitat for fin whales. The fin whales most likely to be observed within the proposed action area are identified as the CA/OR/WA stock.

Spatial Structure and Diversity. Fin whales prefer temperate and polar waters making long-range movements along the entire U.S. West Coast (Falcone et al., 2011) following prey off the continental shelf (Azzellino et al., 2008). There was one sighting of a group of three fin whales during 42 small boat surveys from Grays Harbor out to the 1,000 meters (m) isobath off Quinault conducted over a five-year period in the summer between 2004 and 2009, (Oleson and Hildebrand, 2012). During aerial surveys within the 2,000 m isobath off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012, there were six sightings of 13 fin whales during winter and summer 2012 in offshore waters over the continental slope (Adams et al., 2014). Acoustic monitoring has indicated a yearly seasonal pattern of fin whale calls in the Action Area with the absence of calls from approximately May through July (Oleson and Hildebrand, 2012).

Abundance and Productivity. The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nautical miles is 9,029 whales, generated from a trend-model analysis of line-transect data from 1991 through 2014 (Nadeem et al., 2016).

Limiting factors. Fin whales are susceptible to both ship strikes and entanglement in fishing gear (Carretta et al., 2017; National Oceanic and Atmospheric Administration, 2017). Between 1991 and 201 there were 20 reported ship strikes of fin whales along the U.S. West Coast. From 2010 to 2014 along the U.S West Coast there were nine reported ship strikes to fin whales (Carretta et al., 2017). Since 2002, 10 out of the 12 stranded fin whales in Washington have showed evidence attributed to a large ship strike (Cascadia Research, 2017). Four fin whales were seriously injured by entanglement in fishing gear off the U.S. West Coast between 2007 and 2014 (Carretta et al., 2017; Carretta et al., 2013).

Status of Humpback Whales. Humpback whales were listed as endangered under the Endangered Species Conservation Act in June 1970 (35 FR 18319), and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491). A recovery plan for humpbacks was issued in November 1991 (NMFS, 1991). On September 8, 2016, NMFS published a final rule to divide the globally listed endangered humpback whale into 14 DPSs and place four DPSs as endangered and one as threatened (81 FR 62259). The majority of humpback whales off the coast of Washington from the Hawaii DPS (Calambokidis et al., 2017) were delisted under the ESA. Mexico DPS humpback whales are listed as threatened and Central America DPS humpback whales are listed as endangered. Critical habitat is proposed.

Spatial structure and diversity. Humpback whales are in all major oceans and most seas. They typically spend the summer on high-latitude nearshore feeding grounds and the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs (Barlow et al., 2011; Bettridge et al., 2015; Calambokidis et al., 2017; Calambokidis et al., 2009b). Visual surveys and acoustic monitoring studies detect some humpbacks along the Washington coast year round (Cogan, 2015; Emmons et al., 2019; Oleson et al., 2009). The Central America DPS is composed of humpback whales that breed along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras and Nicaragua and feed almost exclusively offshore of California and Oregon with only a few individuals identified at the northern Washington – southern British Columbia feeding grounds (81 FR 62259). The Mexico DPS consists of humpback whales that breed along the Pacific coast of mainland Mexico, and the Revillagigedos Islands and transit through the Baja California Peninsula coast. The DPS feeds across a broad geographic range from California to the Aleutian Islands, with concentrations in California-Oregon, northern Washington – southern British Columbia, northern and western Gulf of Alaska and Bering Sea feeding grounds (81 FR 62259). Three biologically important humpback whale feeding areas are off of the Washington Oregon coast (Calambokidis et al., 2015); (1) Point St. George off Crescent City, Oregon from July to November (2) Stonewall and Heceta Bank off Newport, Oregon from May to November, and (3) Northern Washington from May–November. Surveys of the Northern Washington feeding area found that humpback whale sightings were concentrated around the edge of what appears to be the semi-permanent eddy associated with the outflow from the Strait of Juan de Fuca (Dalla Rosa et al., 2012). Satellite tag location data from humpback whales indicate a preference for water less than 200 meter deep (Barlow et al., 2011; Becker et al., 2016; Campbell et al., 2015).

Abundance and productivity. Current abundance of the Central America DPS is 411 (81 FR 62259). The current abundance of the Mexico humpback whale DPS is 3,264 (81 FR 62259). A population growth rate is currently unavailable for these DPS. Current estimates of abundance for the CA/OR/WA stock is 1918 individuals with 1729 feeding off California and Oregon and 189 feeding off Washington (NMFS, 2019).

Limiting factors. The most common source of injury to humpback whales along the U.S. Pacific coast is entanglement in pot and trap fisheries (Carretta et al., 2018). There were 54 separate entanglement cases reported for humpback whales along the U.S West Coast in 2016 (National Oceanic and Atmospheric Administration, 2017). For the five-year period between 2011 and 2015 there were 34 cases of entanglement involving pot/trap fisheries and an additional 26 cases of reported interactions with other fisheries (Carretta et al., 2017). Available data from NMFS indicate that along the U.S. Pacific coast between 2011 and 2015, there were nine ship strikes involving humpback whales (Carretta et al., 2018). Humpback whales are also potentially affected by loss of habitat, loss of prey (for a variety of reasons including climate variability), underwater noise, jet skis and similar fast waterborne tourist-related traffic disturbance and vessel strike, and pollutants (Muto et al., 2017).

Status of sperm whales. Sperm whales are listed as endangered under the ESA, but there is no designated critical habitat for this species. Sperm whales in Alaska are from the North Pacific stock. Sperm Whales in the Action Area are from the California, Oregon, Washington stock (Carretta et al., 2017; Carretta et al., 2018).

Spatial structure and diversity. Sperm whales are typically found in temperate and tropical waters of the Pacific (Rice, 1989) but they are also found in areas of higher latitudes in the northern Pacific including Alaska (Whitehead, 2009; Whitehead et al., 2008). Sperm whales have a preference for deep water areas of high productivity, generally near drop offs and areas with strong currents and steep topography (Gannier and Praca, 2007). The semi-permanent the Strait of Juan de Fuca eddy is one such area (MacFadyen et al., 2008). Sperm whales are somewhat migratory. No sperm whales were detected during systematic surveys of waters between the British Columbia border with Alaska and Washington (Williams et al., 2007). Sperm whales were observed twice in deep water off the coast from Grays Harbor In aerial surveys of waters off Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012 (Adams et al., 2014). There were a total of five sperm whale sightings during the NMFS 2014 summer shipboard survey off the coast of Washington (Barlow, 2016).

Abundance and productivity. Estimates of sperm whale total global abundance range from 300,000 and 450,000 individuals (Whitehead, 2009). The California/Oregon/Washington stock abundance is 2,106 individuals (Nmin=1,332), and the Hawaii stock abundance is 3,354 individuals (Nmin=2,539) (Carretta et al., 2019).

Limiting factors. In waters off the U.S. Pacific West Coast between 2011 and 2015, there was one reported ship strike involving a sperm whale in 2012 (Carretta et al., 2017). From 2010 to 2014, a total of five sperm whales were entangled in fishing gear off the U.S. Pacific West Coast (Carretta et al., 2016).

Status of Sei Whale. The sei whale was listed as endangered worldwide under the precursor to the ESA, the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491; June 2, 1970). The entire species remains endangered under the ESA. There is no designated critical habitat for sei whales.

Spatial structure and diversity. Sei whales migrate to spend the summer months feeding in the subpolar higher latitudes and return to lower latitudes as far south as Southern California to calve in the winter (Horwood, 2009). They are found feeding along the California Current, preferring deep water habitat along the continental shelf (Perry et al., 1999). Four sei whales were sighted off Oregon and Washington waters during six ship surveys to 300 nautical miles conducted between 1991 and 2008 (Barlow, 2010). No sei whale were sighted during coastal ship survey to the 200 meter isobaths off the northern Washington coast between 1995 and 2002 (Calambokidis et al., 2004a).

Abundance and productivity. In 2012, the North Pacific Ocean sei whale population is estimated to be 29,632 (95 percent confidence intervals 18,576 to 47,267) (International Whaling Commission, 2016; Thomas et al., 2016).

Limiting factors. Sei whales, because of their offshore distribution and relative scarcity in U.S. Atlantic and Pacific waters, probably have a lower incidence of fishing gear entanglement than fin whales. One sei whale was killed in a collision with a vessel off the coast of Washington in 2003 (National Marine Fisheries Service, 2017e).

Sea Turtles

Status of Leatherback Turtles. We listed leatherback turtles as endangered under the ESA in June, 1970 (35 FR 8491). In 1979, we designated critical habitat for leatherback turtles to include coastal waters adjacent to Sandy Point, St. Croix, U.S. Virgin Island (44 FR 17710). We designated additional critical habitat along the U.S. West Coast in January 2012 (77 FR 4170). We issued the final recovery plan for leatherback turtles in January 1998 (NMFS and USFWS 1998a).

Spatial structure and diversity. A recovery plan for the U.S. Pacific populations of leatherbacks was completed nearly 20 years ago (NMFS and USFWS 1998a), and leatherbacks remain listed globally as an endangered species under the ESA. In 2012, NMFS revised critical habitat for leatherbacks to include additional areas within the Pacific Ocean (77 FR 4170). The revised designation includes approximately 17,000 square miles stretching along the California coast from Point Arena to Point Arguello east of the 3,000 meter depth contour and approximately 25,000 miles stretching from Cape Flattery, Washington, to Cape Blanco, Oregon east of the 2,000 meter depth contour. The principal biological feature identified as essential to leatherback conservation was prey, primarily scyphomedusae.

Leatherback turtles lead a completely pelagic existence, foraging widely in temperate and tropical waters except during the nesting season, when gravid females return to tropical beaches to lay eggs. Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas for foraging in the open ocean, along continental margins, and in archipelagic waters (Morreale et al. 1994; Eckert 1999; Benson et al. 2007a, 2011). In the Pacific, leatherback nesting aggregations are found in the eastern and western Pacific. In the eastern Pacific, major nesting sites are located in Mexico, Costa Rica, and to a lesser extent, Nicaragua. Nesting in the western Pacific occurs at numerous beaches in Indonesia, the Solomon Islands, Papua New Guinea, and Vanuatu, with a few nesters reported in Malaysia and only occasional reports of nesting in Thailand and Australia (Eckert et al. 2012). Leatherbacks nesting in Central America and Mexico migrate thousands of miles into tropical and temperate waters of the South Pacific (Eckert and Sarti 1997; Shillinger et al. 2008). After nesting, females from the Western Pacific nesting beaches make long-distance migrations into a variety of foraging areas including the central and eastern North Pacific, westward to the Sulawasi and Sulu and South China Seas, or northward to the Sea of Japan (Benson et al. 2007a; Benson et al. 2011). The IUCN Red List conducted its most recent assessment of the West Pacific Ocean subpopulation in 2013 and listed it as "Critically Endangered" due in part to its continual decline in nesting, the continued threat due to fishing, and the low number of estimated nesting females.

Abundance and productivity: Leatherbacks occur throughout the world and populations and trends vary in different regions and nesting beaches. In 1980, the leatherback population was approximately 115,000 (adult females) globally (Pritchard 1982). By 1995, one estimate claimed this global population of adult females had declined to 34,500 (Spotila et al. 1996). A current global population estimate is not available at this time, but we provide details on known populations below.

In the Pacific, leatherback populations are declining at all major Pacific basin nesting beaches, particularly in the last two decades (Spotila et al. 1996; Spotila et al. 2000; NMFS and USFWS 2007b). In the eastern Pacific, nesting counts indicate that the population has continued to decline since the mid 1990's, leading some researchers to conclude that the Pacific leatherback is on the verge of extirpation (Spotila et al. 1996; Spotila et al. 2000). Recent estimates of the number of nesting females/year in Mexico and for Costa Rica were reported to be approximately 200 animals or less for each country per year (NMFS and USFWS 2013). More recent estimates show a more positive increasing trend on the nesting beaches in Mexico with an estimated 280 females may have nested along the Pacific coast of Mexico during 2010-12 (Lopez et al. 2012). However, a more disturbing decline has been reported at Las Baulas, Costa Rica, with less than 30 females nesting in recent years.

The Western Pacific leatherback metapopulation that nests in Indonesia, Papua New Guinea, Solomon Islands, and Vanuatu harbors the last remaining nesting aggregation of significant size in the Pacific. This metapopulation is made up of small nesting aggregations scattered throughout the region, with a dense focal point on the northwest coast of Papua Barat, Indonesia; this region is also known as the Bird's Head Peninsula, where approximately 75 percent of regional nesting occurs (Hitipieuw et al. 2007). The Bird's Head region consists of four main beaches, three that make up the Jamursba-Medi (JM) beach complex, and a fourth, which is Wermon beach (Dutton et al. 2007). A decade ago, the nesting population was comprised of an estimated 2,700–4,500 breeding females (Dutton et al. 2007; Hitipeuw et al. 2007). Although there is generally insufficient long-term data to calculate population trends, in all of these areas, the number of nesting females is substantially lower than historical records (Nel 2012). A recent NOAA funded, WWF-Indonesian assessment team identified a new leatherback nesting area in 2017 on three north coast beaches of Buru Island in Central Maluku (WWF 2018 as cited in NMFS and USFWS in prep). Initial monitoring of these beaches suggest that this 10.6 km stretch of shoreline supports the first substantial nesting population discovered outside of Papua, Indonesia in the last decade. Nesting activity appears to be year round with a primary summer nesting peak (May to July) and a secondary winter peak (December to February). During 2017, 203 nests were documented of which 114 were predated, and 16 were depredated (WWF 2018 as cited in NMFS and USFWS in prep).

The most recently available information on the number of nesting females in the Bird's Head region reflects a significant decline. Tapilatu et al. (2013) estimated that the annual number of nests at Jamursba-Medi has declined 78.2 percent over the past 27 years (5.5% annual rate of decline), from 14,522 in 1984 to 1,532 in 2011. The beach at Wermon has been consistently monitored since 2002 and has declined 62.8 percent from 2,944 nests in 2002 to 1,292 nests in 2011 (11.6% annual rate of decline). Collectively, Tapilatu et al. (2013) estimated that since 1984, these primary western Pacific beaches have experienced a long-term decline in nesting of 5.9 percent per year, with an estimated 489 females nesting in 2011. Based on that information, the total number of adult females in the Bird's Head region was estimated to be 1,949 based on summer nests (April-September) (Talipatu et al. 2013; Van Houtan 2014). This represents about 75 percent of the nesting activity in the Western Pacific; therefore NMFS estimated that there were approximately 2,600 nesting females in this population (in NMFS 2014).

Since 2012, monitoring effort at Jamursba-Medi and Wermon beaches has been somewhat variable and the overall nesting trend has continued to decline by 5% (NMFS 2019b). While there appears to be a slight upside to an oscillating trend in recent nesting activity, at the moment it is not affecting the long term trend and more years of data to understand what the upside in the oscillation means for the population (Jones et al. 2018; NMFS 2019b). The current estimate of total nester abundance of females nesting between 2015 and 2017 (i.e., one remigration interval), is 723 females at Jamursba Medi and 554 females at Wermon (UNIPA unpublished data as cited in NMFS and USFWS in prep). Most recently, Jones et al. (2018) estimated the current adult portion of the population is 1,851 (~1390 females). Using this information, NMFS recently estimated the total Western Pacific population is comprised of about 175,000 leatherback sea turtles; potentially ranging between 68,000 and 360,000 individuals NMFS 2019b).

In a recent consultation completed on the Hawaii-based shallow-set longline fishery (NMFS 2019b), NMFS conducted analyses to estimate the growth rate for the Jamursba-Medi and Wermon portion of the Western Pacific leatherback population, along with the probabilities of this subpopulation reaching abundance thresholds within a 100 year projection period, and time in years (mean, median, 95% confidence interval) to reach the threshold for all runs that fall below the threshold (Jones et al. 2018). The results indicated the current mean growth rate lambda (λ) is 0.949 (95% confidence interval 0.849 to 1.061), which suggest that most trajectories of this population can be expected to decrease in the coming years (NMFS 2019b). Although human interactions are a major source of mortality for this declining population, there are indications that natural fluctuations in environmental and oceanic conditions could be significant influences on survival rates across various life stages or on reproductive rates (NMFS 2012c; Van Houtan 2011; Tomillo et al. 2012).

Satellite tracking of post-nesting females and foraging males and females, as well as genetic analyses of leatherback turtles caught in U.S. Pacific fisheries or stranded on the west coast of the U.S., along with stable isotope analysis, all indicate or support that leatherbacks found off the U.S. West Coast are from the western Pacific nesting populations, specifically boreal summer nesters. The exact proportion of the western Pacific population that uses the U.S. west coast is not known, but surveys in neritic waters off central and northern California estimate that, on average, approximately 180 leatherbacks (both males and females, subadults and adults) would be expected to be found in the action area (Benson et al. 2007). In recent years, surveys of leatherback abundance off the U.S. west coast also have detected a decline, although it appears to be less than what has been documented back at the nesting beaches. Given the relative size of the nesting populations, it is likely that the majority of the animals originate from the Jamursba-Medi nesting beaches, although some may come from the comparatively small number of summer nesters at Wermon in Papua Barat, Indonesia. The Jamursba-Medi nesting population generally exhibits site fidelity to the central California foraging area, and it has been estimated that approximately 30 to 60 percent of Jamursba-Medi summer nesters may have foraged in waters off California during some recent years (Benson et al. 2011; Seminoff et al. 2012).

Limiting factors. The primary threats identified for leatherbacks are fishery bycatch and impacts at or adjacent to the nesting beaches, including nesting habitat (erosion, logging, elevated sand temperatures, human/animal encroachment), direct harvest and predation. In the western Pacific, leatherbacks are also subjected to traditional harvest, which was well documented in the 1980s and continues today. Traditional hunters from the Kei Islands continue to kill leatherbacks for consumption and ceremony. Recent surveys indicate that harvest continues with estimates of 431 takes over the past 8 years (53.9/yr), and at least 103 leatherbacks harvested in 2017 (WWF 2018 as cited in NMFS and USFWS in prep). Leatherback are vulnerable to bycatch in a variety fisheries, including longline, drift gillnet, set gillnet, bottom trawling, dredge, and pot/trap fisheries that are operated on the high seas or in coastal areas throughout the species' range. Off the U.S. west coast, a large time/area closure was implemented in 2001 to protect Pacific leatherbacks by restricting the CA thresher shark/swordfish drift gillnet fishery, which significantly reduced bycatch of leatherbacks in that fishery. On the high seas, bycatch in longline fisheries is considered a major threat to leatherbacks (Lewison et al. 2004). In addition to anthropogenic factors, natural threats to nesting beaches and marine habitats such as coastal erosion, seasonal storms, predators, temperature variations, and phenomena such as El Niño also affect the survival and recovery of leatherback populations (Eckert et al. 2012).

There are interactions between leatherbacks and domestic longline fishing for tuna and swordfish based out of Hawaii. Under requirements established in 2004 to minimize sea turtle bycatch (69 FR 17329), vessel operators in the Hawaii-based shallow-set swordfish fishery must use large (sized 18/0 or larger) circle hooks with a maximum of 10 degrees offset and mackerel-type bait. From 2012-2017, the incidental take statement for the Hawaii-based shallow-set fishery was 26 leatherback sea turtles per year, which served as the "hard cap" for the fishery that requires closure of the entire fishery during any year if reached. Recently, the hard cap for leatherback sea turtle bycatch was reset to 16 per year, with the expectations that up to 16 may be caught and 3 may be killed each year and that vessels would be restricted to no more than 2 leatherbacks taken during any one trip (NMFS 2019b). Between 2004 and 2018, there were a total of 105 leatherback sea turtles captured in the fishery, with an estimated 21 leatherback sea turtles killed as a result (NMFS 2019b). In the deep-set longline tuna fishery based out of Hawaii, NMFS exempted the take (interactions or mortalities) of up to 72 interactions and 27 mortalities of leatherbacks over a 3-year period (NMFS 2014). Based on observer data from 20012-2018 (over 20% observer coverage, on average), NMFS estimates that a total of 85 loggerheads were captured, including 36 mortalities (NMFS 2019b). Between 2006, when the observer program started in American Samoa, and 2018 the American Samoa longline fishery is estimated to have had 55 interactions, with 38 mortalities (NMFS 2019c).

Estimating the total number of sea turtle interactions in other Pacific fisheries that interact with the same sea turtle populations as U.S. fisheries is difficult because of low observer coverage and inconsistent reporting from international fleets. Lewison et al. (2004) estimated 1,000 – 3,200 leatherback mortalities from pelagic longlining in the Pacific in 2000. Beverly and Chapman (2007) more recently estimated loggerhead and leatherback longline bycatch in the Pacific to be approximately 20 percent of that estimated by Lewison et al. (2004), which would equate to 200 – 640 leatherbacks during that time period. Chan and Pan (2012) estimated that there were approximately 1,866 total sea turtle interactions of all species in 2009 in the central and North Pacific by comparing swordfish production and turtle bycatch rates from fleets fishing in the Central and North Pacific area. In 2015 a workshop was convened to analyze the effectiveness of sea turtle mitigation measures in the tuna RFMOs and 16 countries provided data on observed sea turtle interactions and gear configurations in the Western Central Pacific Ocean. Based on the information gathered there, 331 leatherback sea turtles reported with a total estimate of 6,620 leatherbacks caught in the region from 1989-2015 in these countries. Most recently, Peatman et al. (2018) estimated that 9,923 leatherbacks were captured in longline fisheries operating in the North Pacific from 2003-2017.

Given that recent developments to reduce sea turtle bycatch in fisheries have been working their way into some international fisheries and the incomplete data sets and reporting that exist, the exact level of current sea turtle bycatch internationally is not clear. However, given the information that is available, we believe that international bycatch of sea turtles in fisheries throughout the Pacific Ocean continues to occur at significant rates several orders of magnitude greater than what NMFS documents or anticipates in U.S. Pacific ocean fisheries.

In an attempt to develop a tool for managers to use locally (e.g. in an EEZ) to reduce threats in a particular area of interest, Curtis et al. (2015) developed biological "limit reference points" for western Pacific leatherback turtles in the U.S. west coast EEZ, similar to a PBR approach calculated for marine mammal stocks. Depending on the model used and the various objectives sought (e.g. achievement of maximum net productivity, or no more than a 10% delay in the time for the population to rebuild) and incorporation of conservative assumptions accounting for broad uncertainty in abundance and productivity estimates, the limit reference point estimate for human-caused removals in the U.S. west coast EEZ ranged from 0.8 to 7.7 leatherbacks over 5 years. Although these results are useful for consideration, NMFS is not currently using this approach to managing threats to sea turtles foraging within the U.S. EEZ pending further discussion of how this approach or other approaches relate to the standards of the ESA. We anticipate that the management tool presented by Curtis et al. (2015) and other approaches to managing threats to sea turtles will be subject to future discussion by scientific experts.

2.2.2 Status of the Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that habitat throughout the designated areas. These features are essential to the conservation of the ESA-listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

For most salmon and steelhead, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each ESA-listed species that they support (NMFS 2005). The conservation rankings were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. Even if a location had poor habitat quality, it could be ranked with a high conservation value if it were essential due to factors such as limited availability, a unique contribution of the population it served, or is serving another important role.

For southern DPS green sturgeon, a team similar to the CHARTs — a critical habitat review team (CHRT) — identified and analyzed the conservation value of particular areas occupied by southern green sturgeon, and unoccupied areas necessary to ensure the conservation of the species (USDC 2009). The CHRT did not identify those particular areas using HUC nomenclature, but did provide geographic place names for those areas, including the names of freshwater rivers, the bypasses, the Sacramento-San Joaquin Delta, coastal bays and estuaries, and coastal marine areas (within 110 m depth) extending from the California/Mexico border north to Monterey Bay, California, and from the Alaska/Canada border northwest to the Bering Strait; and certain coastal bays and estuaries in California, Oregon, and Washington.

For southern DPS eulachon, critical habitat includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). We designated all of these areas as migration and spawning habitat for this species.

We are also providing a conference opinion on proposed critical habitat for Humpback whales.

A summary of the status of critical habitats for many listed species considered in this opinion, is provided in Table 5, below.

Table 5. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this opinion

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 47 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30 watersheds, medium for 13 watersheds, and low for four watersheds.
Upper Columbia River spring-run Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses four subbasins in Washington containing 15 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. We rated conservation value of HUC5 watersheds as high for 10 watersheds, and medium for five watersheds. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Snake River spring/summer-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers (except the Clearwater River) presently or historically accessible to this ESU (except reaches above impassable natural falls and Hells Canyon Dam). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Willamette River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon containing 56 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 22 watersheds, medium for 16 watersheds, and low for 18 watersheds.
Snake River fall-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers presently or historically accessible to this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Columbia River chum salmon	9/02/05 70 FR 52630	Critical habitat encompasses six subbasins in Oregon and Washington containing 19 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 16 watersheds, and medium for three watersheds.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River coho salmon	2/24/16 81 FR 9252	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the lower Columbia River and estuary rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 34 watersheds, medium for 18 watersheds, and low for three watersheds.
Snake River sockeye salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers; Alturas Lake Creek; Valley Creek; and Stanley, Redfish, Yellow Belly, Pettit and Alturas lakes (including their inlet and outlet creeks). Water quality in all five lakes generally is adequate for juvenile sockeye salmon, although zooplankton numbers vary considerably. Some reaches of the Salmon River and tributaries exhibit temporary elevated water temperatures and sediment loads that could restrict sockeye salmon production and survival (NMFS 2015b). Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Washington containing 31 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 20 watersheds, medium for eight watersheds, and low for three watersheds.
Lower Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses nine subbasins in Oregon and Washington containing 41 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 28 watersheds, medium for 11 watersheds, and low for two watersheds.
Upper Willamette River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses seven subbasins in Oregon containing 34 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 25 watersheds, medium for 6 watersheds, and low for 3 watersheds.
Middle Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 15 subbasins in Oregon and Washington containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of occupied HUC5 watersheds as high for 80 watersheds, medium for 24 watersheds, and low for 9 watersheds.
Snake River basin steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 25 subbasins in Oregon, Washington, and Idaho. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Southern DPS of green sturgeon	10/09/09 74 FR 52300	Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
		California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; tidally influenced areas of the Columbia River estuary from the mouth upstream to river mile 46; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor), including, but not limited to, areas upstream to the head of tide in various streams that drain into the bays, as listed in Table 1 in USDC (2009). The CHRT identified several activities that threaten the PBFs in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon).
Southern DPS of eulachon	10/20/11 76 FR 65324	Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington. All of these areas are designated as migration and spawning habitat for this species. In Oregon, we designated 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek. We also designated the mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles. Dams and water diversions are moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath river basins, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods. Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown. Dredging is a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental.

<u>Status of Critical Habitat for Leatherback Sea Turtles</u>. Critical habitat was designated off the U.S. West Coast for leatherback sea turtles (77 FR 4170, January 26, 2012). In the final rule, NMFS identified one primary constituent element essential for the conservation of leatherbacks in marine waters off the U.S. West Coast: the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (e.g., *Chrysaora, Aurelia, Phacellophora,* and *Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks. The critical habitat designation, however, does not specifically define or develop standards or measurable criteria for any of these particular aspects of prey occurrence. The critical habitat designation emphasizes that the preferred prey of leatherbacks off the Oregon coast is jellyfish, with other gelatinous prey, such as salps (a pelagic tunicate), considered of lesser importance.

The CHRT also considered another PBF, water quality to support normal growth, development viability, and health. This PBF would encompass bioaccumulation of contaminants and pollutants and subsequent accumulation in leatherback as well as direct ingestion and contact with contaminants and pollutants. The CHRT eliminated this option because knowledge on how water quality affects scyphomedusae was lacking, and, where data were available, the CHRT believed prey condition, distribution, diversity, and abundance would encompass water quality considerations regarding bioaccumulation. The CHRT also felt that direct ingestion and contact with contaminants and pollutants would be encompassed in a direct effects analysis for the listed species (NMFS 2009b).

<u>Status of Proposed Critical Habitat for Humpback whales</u>

When humpback whales were originally listed, there was no statutory requirement to designate critical habitat for this species. The ESA now requires that, to the maximum extent prudent and determinable, critical habitat be designated at the time of listing. Thus, the listing of DPSs of humpback whales under the ESA in 2016 triggered the requirement to designate critical habitat for the Central American (CAM) and Mexican (MX) DPSs occurring in areas under U.S. jurisdiction. In 2018, a critical habitat review team (CHRT) was convened to assess and evaluate information in support of a critical habitat designation. The CHRT identified a prey biological feature that is essential to the conservation of the whales. The prey essential feature was specifically defined as follows: Prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth. For the endangered CAM DPS of humpback whales, NMFS proposes to designate 48,459 square nautical miles of marine habitat off the coasts of Washington, Oregon, and California as occupied critical habitat that contain the essential prey feature and serve as the only major feeding areas for the CAM DPS; thus, these areas are critical to supporting population growth and recovery of this endangered DPS. For the threated MX DPS of humpback whales, NMFS proposes to designate 175,812 square nautical miles of marine habitat off the coasts of Alaska, Washington, Oregon, and California as occupied critical habitat that are seasonal feeding areas that contain the essential prey feature, and are critical in supporting population growth and recovery of this wide-ranging threatened DPS.

Prey quantity, quality and availability. Whales from these two DPSs travel to U.S. coastal waters specifically to access energy-rich feeding areas, and the high degree of loyalty to specific locations indicates the importance of these feeding areas. Although humpback whales are generalist predators and prey availability can very seasonally and spatially, substantial data indicate that the humpback whales' diet is consistently dominated by euphausiid species (of genus Euphausia, Thysanoessa, Nyctiphanes, and Nematoscelis) and small pelagic fishes, such as northern anchovy (Engraulis mordax), Pacific herring (Clupea pallasii), Pacific sardine (Sardinops sagax), and capelin (Mallotus villosus; Nemoto 1957, Nemoto 1959, Klumov 1963, Rice Krieger and Wing 1984, Baker 1985, Kieckhefer 1992, Clapham et al. 1997, Neilson et al. 2015; See "Diet and Feeding Behavior" and Appendix A in NMFS 2019a).

Because humpback whales only rarely feed on breeding grounds and during migrations, humpback whales must have access to adequate prey resources within their feeding areas to build up their fat stores and meet the nutritional and energy demands associated with individual survival, growth, reproduction, lactation, seasonal migrations, and other normal life functions. Essentially, while on feeding grounds, the whales must finance the energetic costs associated with migration to breeding areas, reproductive activities, as well as the energetic costs associated with their return migration to high-latitude feeding areas. Fat storage has been linked to reproductive efficiency in other species of large, migratory, baleen whales (Lockyer 2007), and some evidence suggests that variation in prey availability during summer is directly connected to variation in annual reproductive rates for humpback whales in the following year (Clapham 1993). Calf condition has also been significantly correlated with female body condition (low calf body condition with lower female condition) for humpback whales in Australia (Christiansen et al. 2016), and, of all life stages, lactating females have the highest energy demands (McMillan 2014). Given the energetic demands of lunging and other prey capture techniques, foraging is only expected to be profitable above some lower threshold for an energetic return, and evidence suggests that humpback whales will only feed when they encounter suitable concentrations of prey. Within their North Pacific feeding areas, humpback whales have often been observed in association with, or specifically targeting, dense aggregations of prey (e.g., Bryant et al. 1981, Krieger and Wing 1986, Goldbogen et al. 2008, Sigler et al. 2012, Witteveen et al. 2015), but the precise range of prey densities required to support feeding are not generally known and therefore cannot be described quantitatively on the basis of the best scientific data available. Thus, it is essential that the whales not only have reliable access to prey within their feeding areas, but that prey are of a sufficient density to support feeding and the build-up of energy reserves.

Features of Critical Habitat for Salmon, Green Sturgeon, and Eulachon

The physical or biological features of freshwater spawning and incubation sites include water flow, quality, and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (Tables 10-13). These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. The physical or biological features of freshwater migration corridors associated with spawning and incubation sites include water flow, quality and temperature conditions supporting larval and adult mobility, abundant prey items supporting larval feeding after yolk sac depletion, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

Table 6. Primary constituent elements, now termed "physical and biological features" (PBFs) of critical habitats designated for ESA-listed salmon and steelhead species considered in the opinion (except SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, and SR sockeye salmon), and corresponding life history events

Primary Constituent Elements Site Type	Primary Constituent Elements Site Attribute	Species Life History Event
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing
Offshore marine areas	Forage Water quality	Adult growth and sexual maturation Adult spawning migration Subadult rearing

Table 7. Essential features of critical habitats designated for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, SR sockeye salmon, and corresponding species life history events.

Essential Features Site	Essential Features Site Attribute	Species Life History Event
Spawning and juvenile rearing areas	Access (sockeye) Cover/shelter Food (juvenile rearing) Riparian vegetation Space (Chinook, coho) Spawning gravel Water quality Water temp (sockeye) Water quantity	Adult spawning Embryo incubation Alevin growth and development Fry emergence from gravel Fry/paar/smolt growth and development
Adult and juvenile migration corridors	Cover/shelter Food (juvenile) Riparian vegetation Safe passage Space Substrate Water quality Water quantity Water temperature Water velocity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Areas for growth and development to adulthood	Ocean areas – not identified	Nearshore juvenile rearing Subadult rearing Adult growth and sexual maturation Adult spawning migration

The physical and biological features of critical habitat are very similar among the listed anadromous fishes. Table 8, presents the features for green sturgeon, and Table 9 the features for eulachon.

Table 8. Physical and biological features of critical habitat designated for southern green sturgeon and corresponding species life history events.

Physical or Biological Features Site Type	Physical or Biological Features Site Attribute	Species Life History Event Species Life History Event
Freshwater riverine system	Food resources Migratory corridor Sediment quality Substrate type or size Water depth Water flow Water quality	Adult spawning Embryo incubation, growth and development Larval emergence, growth and development Juvenile metamorphosis, growth and development
Estuarine areas	Food resources Migratory corridor Sediment quality Water flow Water depth Water quality	Juvenile growth, development, seaward migration Subadult growth, development, seasonal holding, and movement between estuarine and marine areas Adult growth, development, seasonal holding, movements between estuarine and marine areas, upstream spawning movement, and seaward post-spawning movement
Coastal marine areas	Food resources Migratory corridor Water quality	Subadult growth and development, movement between estuarine and marine areas, and migration between marine areas Adult sexual maturation, growth and development, movements between estuarine and marine areas, migration between marine areas, and spawning migration

The CHRT identified several activities that threaten physical and biological features in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon). In addition, petroleum spills from commercial shipping activities and proposed alternative energy hydrokinetic projects are likely to affect water quality or hinder the migration of green sturgeon along the coast (USDC 2009).

Table 9. Physical or biological features of critical habitats designated for eulachon and corresponding species life history events.

Physical or biological feature	Physical or biological feature	Species Life History Event
Site Type	**Site Attribute**	
Freshwater spawning and incubation	Flow Water quality Water temperature Substrate	Adult spawning Incubation
Freshwater migration	Flow Water quality Water temperature Food	Adult and larval mobility Larval feeding

2.3 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The action area is utilized by multiple listed species, and the modified habitat conditions caused by the direct or indirect effects of the proposed action can have greater or lesser influence depending on the species present, timing of presence, lifestage when present, and the duration of presence their presence co-occuring with project effects. Accordingly, we present the baseline here by the species type (fish, marine mammal, or sea turtle).

2.3.1 Baseline for listed fishes

Each fish species considered in this opinion resides in or migrates through the action area in the lower Columbia River and nearshore marine areas (Table 10). The action area is used as rearing and migration habitat by juvenile and adult salmonids. The action area also is used for migration, rearing, and spawning of eulachon and as a rearing corridor for subadult green sturgeon.

Table 10. Presence of ESA-listed fish species in the Lower Columbia River by life stage, NMFS' Northwest Fisheries Science Center, and NMFS' Protected Resources Division.

Species	Life Stage	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
		░	=present							▒	= relatively abundant							▓	= peak occurrence						
Eulachon																									
Southern	Adult migr. & holding[1, 2]	▒	▒	▓	▓	▓	▓	▒	▒	▒														▒	▒
DPS	Adult spawning[2]	▒	▒	▓	▓	▓	▓	▒	▒	▒														▒	▒
	Egg incubation[3]	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒													▒	▒
	Larvae emigration	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒													
Sturgeon: Green																									
Southern	Juvenile rearing[2]									░	░	▒	▒	▒	▒	▒	▒	▒	▒	▒					
Salmon: Chinook																									
Lower	Adult migr. & holding					▒	▒	▒	▒	▓	▓	▓	▓	▓	▒	▒	▒	▒	▒	▒	▒				
Columbia	Adult spawning																								
	Eggs & pre-emergence																								
	Juvenile rearing	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒
	Juvenile emigration					▓	▓	▒	▓	▓	▓	▓	▓	▓	▓	▓	▓	▒	▒	▒	▒	▒	▒		
Upper	Adult migr. & holding									░	▓	▓													
Columbia	Adult spawning																								
	Eggs & pre-emergence																								
	Juvenile rearing																								
	Juvenile emigration					▓	▓	▒	▓	▓	▓	▓	▓	▓	▓	▓	▓	▒	▒	▒	▒	▒	▒		
Upper	Adult migr. & holding					▒	▒	▒	▒	▓	▓	▓	▒												
Willamette	Adult spawning																								
	Eggs & pre-emergence																								
	Juvenile rearing	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒
	Juvenile emigration			▒	▒	▒	▒	▒	▓	▓	▓	▓	▒	▒	░	░	░	░	░	░	░	░	░		
Snake River -	Adult migr. & holding					▒	▒	▓	▓	▓	▒	▒	▒	▒	▒	▒	▒	▒	▒						
	Adult spawning																								
	Eggs & pre-emergence																								
	Juvenile rearing																								
	Juvenile emigration					▒	▒	▒	▓	▓	▓	▓	▒	▒	▒	▒	░	░	░	░	░				
Snake River -	Adult migr. & holding							▒	▒	▓	▓	▓	▓	▓	▒	▒	▒	▒	▒						
Fall	Adult spawning																								
	Eggs & pre-emergence																								
	Juvenile rearing	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒	▒
	Juvenile emigration			▒	▒	▓	▓	▒	▓	▓	▓	▓	▓	▓	▓	▓	▓	▒	▒	▒	▒	▒	▒	▒	▒

=present | = relatively abundant | = peak occurrence

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Salmon: Chum													
Columbia	Adult migr. & holding												
River	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration[4]												
Salmon: Coho													
Lower	Adult migr. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Salmon: Sockeye													
Snake River	Adult migr. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Steelhead													
Lower	Adult migr. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Middle	Adult migr. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper	Adult migr. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper	Adult migr. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												

		=present				= relatively abundant				= peak occurrence			
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Snake River	Adult migr. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												

[1] Eulachon Status Review Update, 20 January 2010. Available at: http://www.nwr.noaa.gov/Other-Marine-Species/upload/eulachon-review-update.pdf

[2] Personal communication. Conversation between WDFW (Brad James, Olaf Langness, and Steve West), ODFW (Tom Rien), and NMFS (Rob Markle, Bridgette Lohrman) regarding green sturgeon and eulachon presence in the Columbia River. June 23, 2009.

[3] Eulachon egg incubation estimated relative to spawning timing and 20 to 40 day incubation period.

[4] Carter et al. 2009 (Seasonal juvenile salmonid presence and migratory behavior in the lower Columbia River).

As described above in the Status of the Species and Critical Habitat sections, habitat factors present in the action area that limit the recovery of listed fishes vary based on the variety private, state, and Federal activities in-water and on adjacent lands. Within the action area, many stream and riparian areas have been degraded by the effects of land and water use, including road construction, forest management, agriculture, mining, transportation, urbanization, and water development. Each of these economic activities has contributed to a myriad of interrelated factors for the decline of species considered in this opinion. Among the most important of these are changes in stream channel morphology, degradation of spawning substrates, reduced instream roughness and cover, loss and degradation of estuarine rearing habitats, loss of wetlands, loss and degradation of riparian areas, water quality degradation (e.g., temperature, sediment, dissolved oxygen), blocked fish passage, direct take, and loss of habitat refugia. Climate change is likely to play an increasingly important role in determining the abundance of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest.

Anadromous salmonids that spawn, rear, or migrate in the Snake and Columbia River and their tributaries have been affected by the development and operation of dams. Dams, without adequate fish passage systems, have extirpated anadromous fish from their pre-development spawning and rearing habitats. Dams and reservoirs, within the currently accessible migratory corridor, have greatly altered the river environment and have affected fish passage. The operation of water storage projects has altered the natural hydrograph of many rivers. Water impoundment and dam operations also affect downstream water quality characteristics, vital components to anadromous fish survival. In recent years, high quality fish passage is being restored where it did not previously exist, either through improvements to existing fish passage facilities or through dam removal, e.g., Marmot Dam on the Sandy River and Powerdale Dam on the Hood River.

Within the habitat currently accessible by species considered in this opinion, dams have negatively affected spawning and rearing habitat. Floodplains have been reduced, off-channel habitat features have been eliminated or disconnected from the main channel, and the amount of large woody debris in the mainstem has been greatly reduced. Remaining habitats often are affected by flow fluctuations associated with reservoir water management for power peaking, flood control, and other operations.

The development of hydropower and water storage projects within the Columbia River Basin have resulted in the inundation of many mainstem spawning and shallow-water rearing areas (loss of spawning gravels and access to spawning and rearing areas); altered water quality (reduced spring turbidity levels), water quantity (seasonal changes in flows and consumptive losses resulting from use of stored water for agricultural, industrial, or municipal purposes), water temperature (including generally warmer minimum winter temperatures and cooler maximum summer temperatures), water velocity (reduced spring flows and increased cross-sectional areas of the river channel), food (alteration of food webs, including the type and availability of prey species), and safe passage (increased mortality rates of migrating juveniles) (Ferguson et al. 2005; Williams et al. 2005).

Anadromous fish considered in this opinion are exposed to high rates of predation during all life stages. Fish, birds, and marine mammals, including harbor seals, sea lions, and killer whales all prey on juvenile or adult salmon. The Columbia River Basin has a diverse assemblage of native and introduced fish species, some of which prey on salmon, steelhead, and eulachon. The primary resident fish predators of salmonids in many areas of the State of Oregon inhabited by anadromous salmon are northern pikeminnow (native), smallmouth bass (introduced), and walleye (introduced). Other predatory resident fish include channel catfish (introduced), Pacific lamprey (native), yellow perch (introduced), largemouth bass (introduced), and bull trout (native). Increased predation by non-native predators has and continues to decrease population abundance and productivity.

Avian predation is another factor limiting salmonid recovery in the Columbia River Basin. Throughout the basin, piscivorous birds congregate near hydroelectric dams and in the estuary near man-made islands and structures. Avian predation has been exacerbated by environmental changes associated with river developments. Water clarity caused by suspended sediments settling in impoundments increases the vulnerability of migrating smolts. Delay in project reservoirs, particularly immediately upstream from the dams, increases smolt exposure to avian predators, and juvenile bypass systems concentrate smolts, creating potential feeding stations for birds. Dredge spoil islands, associated with maintaining the Columbia River navigation channel, provide habitat for nesting Caspian terns and other piscivorous birds. Caspian terns, double-crested cormorants, glaucous-winged/western gull hybrids, California gulls, and ring-billed gulls are the principal avian predators in the basin. As with piscivorous predators, predation by birds has and continues to decrease population abundance and productivity.

Approximately 1,643 OGVs enter and leave the Lower Columbia River each year, totaling about 3,286 transits entering and leaving the LCR. These transits are drivers of baseline conditions related to wake stranding, discussed below.

Wake stranding is another factor limiting salmonid recovery in the Columbia River Basin. Below Bonneville dam, several studies have observed stranded juvenile salmon resulting from shipwakes created by OGVs in several locations. While it is impossible to numerically predict the effects on baseline conditions on Columbia River salmonid populations, wake stranding occurs every year with the most stranding occurring during spring months when juvenile salmonids are at their highest numbers in the lower river. An ongoing effort to monitor wake stranding has been occurring upstream of the CET, at the mouth of the Lewis River at Columbia River mile 87. This 8-year study has confirmed wake stranding of ESA-listed salmonids each year resultant from OGVs and other smaller watercraft (Jorgenson pers comm January 21, 2020). Wake stranding contributes to decreased population abundance and recovery for all salmonids in the Columbia River system, with the highest mortalities on Lower Columbia Chinook, LC chum, and LC coho salmon.

The environmental baseline includes the anticipated impacts of all Federal actions in the action area that have already undergone formal consultation. For example, from 2007 through 2012, the Corps authorized 280 restoration actions in Oregon under the SLOPES programmatic consultation and another 397 actions for construction, minor discharge, over- and in-water structures, transportation, streambank stabilization, surveys, and utility lines in habitat affecting

ESA-listed fish species (NMFS 2008a; NMFS 2008b). The Corps also consulted on the Kalama Methanol Terminal (WCR-2015-3594), which will add up to 72 OGV trips in the Lower Columbia River. The Corps, Bonneville Power Administration (BPA), and Bureau of Reclamation have consulted on large water management actions, such as operation of the Federal Columbia River Power System, the Umatilla Basin Project, and the Deschutes Project. The U.S. Bureau of Indian Affairs (BIA), U.S. Bureau of Land Management, and the U.S. Forest Service USFS have consulted on Federal land management throughout Oregon and Washington, including restoration actions, forest management, livestock grazing, and special use permits. The BPA, NOAA Restoration Center, and USFWS have also consulted on large restoration programs that consist of actions designed to address species limiting factors or make contributions that would aid in species recovery.

In general, the aquatic habitat of the Columbia River at the project sites provides habitat for a variety of benthic, epibenthic, and water column organisms. The shape, composition, and configuration of benthic topography are in a state of relatively constant change in the reach of the Columbia River in the action area, due to natural processes. Sand waves naturally form and propagate along the channel and the adjacent river bottom, with the estimated volume of sand in a single large sand wave in a range of between 100,000 to 200,000 cubic yards. Substrate within both subtidal and intertidal benthic environments consists largely of silts and medium-to-coarse alluvial sands. There is no submerged aquatic vegetation in this reach of the river, most likely due to the dynamic nature of the system and the high water velocities.

Water quality conditions (turbidity, pH, and dissolved oxygen) at the project sites are generally within the range needed to support aquatic life. The majority of the river in the vicinity of the action area is not identified on the Washington State Department of Ecology 303(d) list for elevated water temperatures. However, two areas on the Columbia River, near the project site (one at RM 71.9 and one at RM 74) are listed for temperature exceedances. Data published by the U.S. Geological Survey in 2012 indicate that summer water temperatures downstream of Bonneville Dam routinely exceed 70°F (Tanner *et al.* 2012), compared to optimal 55°F for incubation of eggs to 68°F for adult migration.

The States of Washington and Oregon require that ballast water be exchanged at sea or treated to eliminate living organisms prior to discharge (WDFW 2009, ODEQ 2011). In addition, NMFS developed a biological opinion addressing the United States Coast Guard’s National ballast water management program and initial numerical standard. NMFS found that the discharge of ballast water using the initial numerical standard is not likely to jeopardize the continued existence of endangered or threatened species in the Columbia River (and elsewhere) (NMFS 2012). The CET will dispose of initial dredged material at the Ross Island lagoon. Effects from disposal at the federally and State authorized Ross Island lagoon were analyzed in a previous Opinion (WCR-2016-5734, NWR-2000-468, WR-2007-158).

2.3.2 Baseline for listed marine mammals.

In addition to the habitat conditions affecting fishes, described above, the environmental baseline description below refers to the past and present impacts of all Federal, State, or private actions and other human activities in the action area that affected marine mammal stocks.

<u>Ship Strikes, Entrapment and Entanglement</u>. OGVs transiting the action area may interact with whales and leatherback sea turtles. Ship strikes have been identified as a significant source of mortality to endangered whales (Kraus 1990) and sea turtles (Hazel *et al*. 2007). The WCR maintains a stranding database and includes marine mammal death and injury records from ship strikes, which extends beyond the action area. So, the number of strikes occurring in the action area is a small portion of the total strikes along the United States West Coast. According to the Columbia River Bar dispatch center, 2,830 bar crossings were recorded in 2018, for a total of 1,615 OGVs. At full capacity, the CET project would add 1680 bar crossings, or about 2.3 per crossings per day, increasing the 2018 number by approximately 59%. The total number of vessels transiting the ocean portion of the action area (which includes OGVs from all west coast ports) where ship strikes occur, is unknown. In addition to OGV interactions, whale species may interact with fishing gear. Entrapment and entanglement in fishing gear has also been identified as a significant source of mortality to endangered whales (Caretta *et al*. 2013).

Blue Whales

Ship Strikes. From 1998-2013, the total estimated number of observed or assumed mortality and serious injury attributed to ship strikes off the U.S. West Coast is approximately 13 blue whales (WCR Stranding Database). Ship strikes were implicated in the deaths of nine blue whales, from 2007-2011 (Carretta *et al*. 2013). Five of these deaths occurred in 2007, the highest number recorded for any year. The other ship strike deaths occurred in 2009 (2 whales) and in 2010 (2 whales). During this time period, there were an additional four serious injuries (i.e., an injury that is more likely than not to result in mortality) of unidentified large whales attributed to ship strikes (Carretta *et al*. 2013). Several blue whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (Carretta *et al.* 2014). Blue whale mortality and injuries attributed to ship strikes in California waters averaged 1.9 per year during 2007-2011. The high number of ship strikes observed in 2007 resulted in NOAA implementing a mitigation plan that includes NOAA weather radio and USCG advisory broadcasts to mariners entering the Santa Barbara Channel to be observant for whales, along with recommendations that mariners transit the channel at 10 knots or less. The Channel Islands National Marine Sanctuary also developed a blue whale ship strike response plan. Additional plan information can be found at http://channelislands.noaa.gov/focus/alert.html. Documented ship strike deaths and serious injuries are considered minimum values because they are derived from counts of whale carcasses which have consistently low detection rates. Because of this negative bias, Redfern *et al*. (2013) stress that the number of ship strike deaths of blue whales in the California current likely exceeds the potential biological removal (*i.e.,* 2.3 whales per year; Carretta *et al*. 2014).

Entrapment and Entanglement in Fishing Gear. Entrapment and entanglement in fishing gear has been identified as a significant source of mortality to endangered whales (Caretta *et al*. 2013). The California thresher shark/swordfish drift gillnet fishery (DGN; ≥14 inch mesh) is the only fishery that is likely to take blue whales from the Eastern North Pacific stock, but no fishery mortality or serious injuries have been observed since 1990 (Carretta *et al*. 2014); however, blue whales have been documented with scars from injuries likely caused by interaction with some type of gear (J. Calambokidis, personal communication, 2014).

Fin Whales

Ship Strikes. Fin whales have been reported struck and killed by large vessels along the entire West Coast. From 1998-2013, the total estimated number of observed or assumed mortality and serious injury attributed to ship strikes off the U.S. West Coast is approximately 19 fin whales (WCR Stranding Database). At least one, and probably more, fin whales were killed by collisions with ships off California in the early 1990s (Barlow *et al.* 1997). Ship strikes were implicated in the deaths of seven fin whales and serious injury of one fin whale between 2007 and 2011. In 2008, one fin whale was struck and brought into the port of Los Angeles on the bow of a ship. In 2009, a total of four fin whales were reported as struck: two were struck off of San Clemente Island in Southern California, one came in on the bow of a vessel into Los Angeles Harbor, and one came in on a bow of a vessel into Tacoma, Washington. In 2010, a fin whale came in on the bow of a vessel in the port of Oakland, near San Francisco, CA. The whale was towed out to sea and within a few days another fin whale washed ashore near San Francisco with injuries believed to have been caused by a ship strike. It is possible that this animal was the same animal as the one that came in on the vessel in Oakland; however, DNA evidence confirming the match was not available; thus both animals are counted as individual ship strikes. An adult female fin whale was also killed in 2011, and stranded in San Diego, CA, where it expelled a fetus, post-mortem. Additional mortality from ship strikes probably goes unreported because the whales do not strand, or if they do, they do not always have obvious signs of trauma (Carretta et al. 2014). Between 2007 and 2011, the average observed annual mortality and serious injury due to ship strikes was 1.6 fin whales per year (Carretta et al. 2014).

Entrapment and Entanglement in Fishing Gear. According to the 2013 Stock Assessment Report (SAR), the California thresher shark/swordfish DGN fishery is the only fishery that has been identified as taking (*i.e.,* killing) a fin whale from the California/Oregon/Washington stock (Carretta et al. 2014). We reviewed records from 1998 through 2013 and estimate that the total serious injury or mortality due to fisheries is four fin whales total over that time period; however the last known observed take of fin whales in fisheries was over 15 years ago.

Humpback Whales

Ship Strikes. From 1998-2013, the total estimated number of observed or assumed mortality and serious injury attributed to ship strikes off the U.S. West Coast is approximately 11 humpback whales (WCR Stranding Database). Ship strikes were implicated in the deaths of at least two humpback whales in 1993, one in 1995, and one in 2000 (J. Cordaro, NMFS unpublished data, in Carretta et al. 2006). In 2004, a humpback whale stranded dead in Washington with injuries consistent with those caused by a ship strike. In 2005, a free-swimming humpback whale was reported to have been hit by a USCG vessel in San Francisco Bay. No blood was visible in the water, but the final status of this animal remains unknown. In 2007, a humpback whale cow/calf pair swam into the Sacramento River with injuries consistent with a ship strike. The injuries appeared non-fatal as the animals eventually left the River and headed back into the Pacific Ocean. Also in 2007, a humpback whale stranded dead in Marin County, California, with a fractured skull, consistent with a ship strike. In 2008, in Washington, two humpback whales stranded dead with injuries consistent with those caused by a ship strike. In 2011, a humpback whale stranded dead with a large contusion near the dorsal fin, in Los Angeles County, California with injuries consistent with those caused by a ship strike. In 2013, one humpback whale was killed by a ship strike and stranded dead in Marin County, California. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not have obvious signs of trauma. Several humpback whales have been photographed in California with large gashes in their dorsal surface that appear to be from ship strikes (Carretta et al., 2012).

The 5-year average number of humpback whale deaths by ship strikes off the West Coast of the U.S. from 2007-2011 as reported in Carretta et al. (2014) is 1.1 humpback whales per year. The 5-year average number of humpback whale deaths by ship strikes off the West Coast of the U.S. considered in this analysis from 2009-2013 is 0.60 humpback whales per year, but this is considered a minimum since animals struck by ships may not be realized or reported.

Entrapment and Entanglement in Fishing Gear. Humpback whales are the most commonly observed whale species to interact with fishing gear. This may be due to their distribution, often feeding in coastal waters. It may also be related to the humpbacks' anatomy; humpback whales have very long pectoral flippers, up to a third of their overall body length and gear is commonly found entangled on their pectorals. Humpbacks have been reported interacting with gillnets, a variety of pot/trap fisheries and unknown fisheries.

A number of fisheries based out of west coast ports may incidentally interact with the Central America or Mexican DPS of humpback whale, and documented interactions are summarized in the 2013 SAR (Carretta et al. 2014). We reviewed records from 1998 through 2013 and estimate that the total serious injury or mortality due to fisheries is 53 humpback whales. This estimate is likely an under estimate since many of the pot/trap fisheries do not carry observers and the only available information on these interactions is opportunistic. There were 22 unidentified whales observed entangled in pot/trap gear or unknown gillnet gear during 1998-2013. Some of these animals may represent re-sightings of entangled humpback whales accounted for above. It is likely that most of the unidentified pot/trap fishery entanglements involved humpback whales. Other unobserved fisheries may also result in injuries or deaths of humpback whales (Carretta et al. 2014).

<u>*Humpback Whale Proposed Critical Habitat*</u>

The ocean action area overlaps proposed critical habitat for the Mexico and Central America DPS of humpback whales. Baseline conditions for proposed critical habitat of humpback whale includes those ongoing effects of ship strikes, acoustic disturbance, and entanglement in fishing gear. Increasing levels of anthropogenic sound in the world's oceans, such as those produced by shipping traffic, Acoustic Thermometry of Ocean Climate or Low Frequency Active sonar, have been suggested to be a concern for whales, particularly for baleen whales (fin, humpback, and blue) that may communicate using low frequency sound. Based on vocalizations, reactions to sound sources, and anatomical studies, humpback whales also appear to be sensitive to mid-frequency sounds, including those used in active sonar military exercises. We do not have specific information about what types of acoustic disturbance is in the action area; however, we expect noise from shipping, boating associated with commercial and recreational fishing, and Coast Guard operations.

Sperm Whales

Ship Strikes. From 1998-2013, the total estimated number of observed or assumed mortality and serious injury attributed to ship strikes off the U.S. West Coast is approximately 4 sperm whales (WCR Stranding Database). Sperm whales interactions with large vessels are rarely reported within the proposed action area, although they are likely vulnerable to ship strikes off the West Coast of the U.S. Carcasses that do not drift ashore may go unreported, and those that do strand may show no obvious signs of having been struck by a ship. Two whales described as "possibly sperm whales" are known to have died in U.S. waters in 1990, after being struck by vessels (Barlow et al. 1997). In 2007, in Florence, OR, a calf stranded dead with obvious signs of propeller trauma, a deep gash on its dorsal side, and the caudal end of the body cut off at the peduncle. In 2009, a sperm whale carcass washed ashore at Point Reyes, California with severe bruising and hemorrhaging along the dorsum, consistent with injuries likely to have been caused from a ship strike.

From 2001-2013, the total number of observed or assumed mortality and serious injury (M/SI) attributed to ship strikes is 3.0, resulting in an annual average of 0.23 sperm whales.

Entrapment and Entanglement in Fishing Gear. Sperm whales have been observed interacting with fishing gear, specifically with the California thresher shark/swordfish drift gillnet fishery ($\geq$14 inch mesh). The whales were likely from the California/Oregon/Washington sperm whale stock. With regard to other known fisheries interactions, one sperm whale was found dead in Marin County, California in 2004, with monofilament netting in its stomach (WCR Stranding Network Database 2014). It is not known if the marine debris was the cause of death. Similarly, in 2008, two sperm whales stranded dead: one was found in Crescent City, California with a stomach full of a variety of different nets; and the other in Point Reyes, California with a variety of different netting, a plastic tarp, and rope marks on its pectoral flipper. Also, in 2008, an animal stranded dead in North Cove, Washington, with apparent entanglement scars. For the sperm whales found stranded dead in 2008, investigators could not determine the animals' primary cause of death was interactions with gear; however, it seems possible entanglement could have been related to their death. We reviewed records from 1998 through 2013 and estimate that the total serious injury or mortality due to fisheries is 25 sperm whales total over that time period.

Sei Whales

Ship Strikes. One documented ship strike of a sei whale occurred in the most recent 5-year period, 2012-2016 (Carretta et al. 2018b), although uncertainty over whether the strike occurred pre- or post-mortem exists. During 2012-2016, there was one additional serious injury of an unidentified large whale attributed to a ship strike. Additional ship strike mortality probably goes unreported because the whales do not strand or, if they do, they may not have obvious signs of trauma. The average observed annual mortality due to ship strikes is 0.2 sei whales per year for the period 2012-2016.

*Entrapment and Entanglement in Fishing Gear***.**
Sei whales, because of their offshore distribution and relative scarcity in U.S. Atlantic and Pacific waters, probably have a lower incidence of fishing gear entanglement than other large whales.

Acoustic Disturbance. Increasing levels of anthropogenic sound in the world's oceans (Andrew et al. 2002), such as those produced by shipping traffic, Acoustic Thermometry of Ocean Climate or Low Frequency Active sonar, have been suggested to be a habitat concern for whales, particularly for baleen whales (fin, humpback, and blue) that may communicate using low frequency sound. Based on vocalizations (Richardson et al. 1995; Au et al. 2006), reactions to sound sources (Lien et al. 1990, 1992; Maybaum 1993), and anatomical studies (Hauser et al. 2001), humpback whales also appear to be sensitive to mid-frequency sounds, including those used in active sonar military exercises (Navy 2007). We do not have specific information about what types of acoustic disturbance is in the action area; however, we expect noise from past and present activities, including shipping, boating associated with commercial and recreational fishing, and Coast Guard operations.

Other Threats (all whales). NMFS issues scientific research permits to allow research actions that involve take of whales. Currently there are 12 permits that allow directed research on whales, typically involving either targeted capture or sampling of individuals that may have stranded or incidentally taken in some other manner. These permits allow a suite of activities that include observation, tagging, tracking, and collection of biological data and samples. These activities are intended to be non-injurious, with only minimal short term affects. But the risks of incurring an injury or mortality as a result of directed research cannot be eliminated.

2.3.3 Baseline for Leatherback Sea Turtles

As described above in the status section, leatherback sea turtles have been and continue to be affected by numerous activities within the proposed action area. Here we look at the past and present impacts of all Federal, State, or private actions and other human activities in the action area to leatherback sea turtles.

Fisheries Interactions. All sea turtle species are occasionally reported and observed interacting with fishing gear, including pot/trap gear, gillnets, and hook and line recreational gear, with leatherbacks interacting with gear the most. Sea turtles have not been observed entangled in the salmon or coastal pelagic species fishing gear. An interaction between gear used in the Federal groundfish fishery and a leatherback was observed when a dead leatherback was found entangled in sablefish trap gear fishing offshore of Fort Bragg in October, 2008. The former NMFS Northwest Region (NWR) (which was subsequently merged with the Southwest Region to form the West Coast Region) completed a section 7 consultation (NMFS 2013b) on the Federal groundfish fishery and issued an incidental take statement for leatherback sea turtles. The opinion found no jeopardy to leatherback sea turtles. Leatherback turtles are also observed in California drift gillnet fishery (CDGN) (Curtis et al, 2015). This opinion (NMFS, 2012/03020) also found no jeopardy to leatherback turtles, and issued take of up to 2 turtles per year. The Pacific Island Regional Office of NMFS also consulted on the Hawaii longline fishery (PIR 2018-10335), and set an annual interaction limit of 16 leatherback turtles.

Ship Strikes. Ship strikes are occasionally a source of injury and mortality to sea turtles along the West Coast. A review of the stranding database indicates that leatherbacks are reported most often as stranded due to the impact by vessels strikes compared to other sea turtles along the West Coast. Confirmed stranding data related to ship strikes is not available for the Oregon Coast. In this case, we looked at stranding data from California as a comparison. As with California, vessel strikes to leatherback sea turtles are likely to occur, as the Columbia River plume is a foraging area for leatherback sea turtles, which overlaps with current shipping routes. Between 2000 and 2005, there were three reported boat collisions with leatherbacks off the California coast, and fate of these turtles is unknown (SWR stranding data base). Two of the reports documented damage to the carapace, head, or flippers. In 2008, there was another boat collision reported off Cayucos Point, California and the turtle was observed dead (Caretta et al. 2013). Ship strikes likely go largely unreported, and may pose a threat to leatherbacks in foraging areas like the Gulf of the Farallones in Northern California (Benson et al. 2007b).

Other Threats. Sea turtles, particularly olive ridleys, have stranded off the West Coast through their encounters with marine debris, either through ingesting debris or becoming entangled in the debris (NMFS 2009b). Other threats include unknown injuries, illness, gunshot wounds and cold-stunning (Figure 8). Because not all stranded sea turtles are necropsied, particularly leatherbacks, many threats are not documented, but all strandings are recorded in the stranding database (Figure 9).

NMFS issues scientific research permits to allow research actions that involve take of sea turtles. Currently there are four permits that allow directed research on sea turtles, typically involving either targeted capture or sampling of individuals that may have stranded or incidentally taken in some other manner. These permits allow a suite of activities that include tagging, tracking, and collection of biological data and samples. These activities are intended to be non-injurious, with only minimal short-term effects. But the risks of a incurring an injury or mortality cannot be eliminated as a result of directed research.

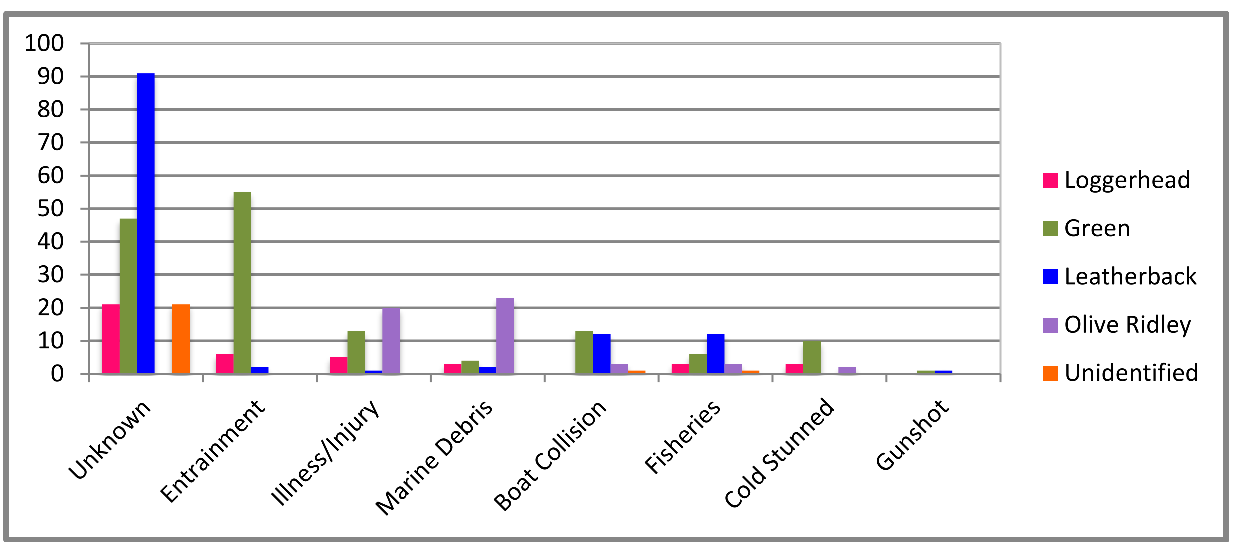

Figure 9. Known causes of sea turtle strandings off the U.S. West Coast, 1957 - 2009.

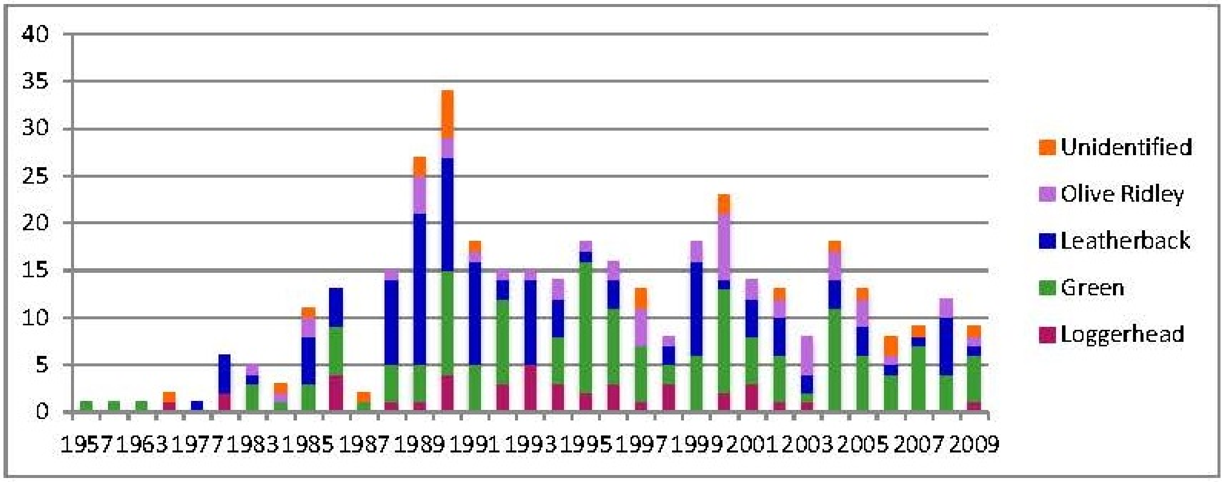

Figure 10. Sea turtle strandings documented off the U.S. West Coast, 1957 – 2009.

2.4 Effects of the Action on Species and Designated Critical Habitat

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

The effects of the proposed action will affect all salmon and steelhead in this opinion in a similar manner. This is because all of these ESUs and DPSs have similar life history, biology, and behavior. Green sturgeon and eulachon, like salmon and steelhead, are anadromous fish although their life history and biology is somewhat different than salmon and steelhead. Where the effects of the action may impact these species slightly differently, it is noted in our analysis below.

For this consultation, we do not consider any impacts from the burning of fuels shipped from the CET, including the production of greenhouse gases, to be indirect effects of the action. This is because we cannot show a causal connection between the emissions of greenhouse gasses from the proposed agency action and specific localized climate change as it impacts listed species or critical habitat with reasonable certainty.[2]

[2] May 14, 2008, Memorandum from Mark Meyers (USGS) to the US Fish and Wildlife Service Director ("The Challenges of Linking Carbon Emissions, Atmospheric Greenhouse Gas Concentrations, Global Warming, and Consequential Impacts"), which cites several findings of the Intergovernmental Panel on Climate Change (2007) Fourth Assessment Synthesis Report. In particular, the IPCC noted difficulties in simulating and attributing observed temperature changes at smaller than continental scales, because it is a fundamental property of atmospheric CO_2 that it is considered to be "well-mixed", i.e., its residence time in the troposphere is long enough that it becomes homogeneous both vertically and horizontally (i.e., distributed world-wide) and because at smaller than continental scales there are spatially heterogeneous forcings, such as those arising from changes in aerosol loadings and land use patterns, which may have large impacts on regional climate.

2.4.1 Effects on Critical Habitat

Designated critical habitat within the action area for the ESA-listed fish species considered in this opinion consists primarily of freshwater rearing sites, freshwater and estuarine migration corridors. Proposed critical marine critical habitat within the action area for ESA-listed marine mammals and turtles consist of open water marine areas for migration and forage. The essential physical and biological features are listed below. Completion of the action is likely to have the following effects on the PBFs or habitat qualities essential to the conservation of each species.

Green sturgeon critical habitat is designated in the project area. Vessels will transit through green sturgeon critical habitat in the greater action area (downstream of the project site). We do not expect any effects on green sturgeon critical habitat as a result of vessel traffic. However, effects from dredging and in-water dredge disposal will result in adverse effects on green sturgeon critical habitat, causing avoidance and temporary disruption of forage.

Docks 2 and 3 and their associated trestle will result in 4.83 acres of new shading,nominally 0.3 acres (up to 13,400 sf) of which is in shallow water (<20 ft). Piles will displace 3,754 square feet of substrate, 184 square feet of which is in shallow water. Shade, displaced substrate, and sediment disturbance are likely to affect the following features of critical habitat:

Prey Abundance

Shade. Shade can typically reduce juvenile salmonid prey organism abundance by reducing aquatic vegetation and phytoplankton abundance (Kahler et al., 2000, Carrasquero 2001). Glasby (1999) found that epibiotic assemblages on pier pilings subject to shading were markedly different than in surrounding areas. There is no submerged aquatic vegetation in this reach of the river, most likely due to the dynamic nature of the system and the high water velocities. The structure and composition of benthic organisms are constantly in a state of change in this reach of the Columbia River, due to the sand waves that naturally form and propagate along the river bottom. These sand waves move organisms down the river channel as they form and reform. New piles may eliminate substrate available to benthic aquatic organisms and therefore, eliminate a possible food source for juvenile salmonids and eulachon larvae and juveniles in the project area. However, placement of piles and associated structures has also been shown to provide foraging habitat, and may partially compensate for loss of benthic productivity. Carrasquero (2001) states that juvenile salmonids will feed upon periphyton, insects, and macroinvertebrates adhered to dock and pier pilings in the Columbia River.

Dredging. As proposed, the CET will require initial dredging of around 350,000 cy, and includes a 10-year maintenance dredge program for lesser volumes around docks 2 and 3. The initial dredge will temporarily reduce food production in an approximate 41.5 acre area by disturbing benthic habitat and benthic productivity. After initial dredging, a smaller volume estimated between 5,000 and 24,000 cy would be dredged as needed on a multi-year basis. Available forage from sources outside of the action area will remain at current levels. Benthic invertebrates provide the primary food source for ESA-listed fish – dominated by families of midges (Johnson et al. 2011). The aquatic invertebrates occupy the upper surface of the river bottom with a life cycle of many weeks to months before emerging into the water column. The level and nature of the disturbance is not unlike natural processes that continually move river bottom sediments, burying or eroding benthic habitat. Recolonization of the benthic habitat is rapid – within weeks to months (McCabe et al. 1998). As such, we expect loss of forage in the dredge prism to recover prior to the following spring after the initial dredging as well as after each subsequent maintenance dredge. However, this temporary loss of forage will reduce available forage several months as benthic recolonization occurs. As such, reduction of forage is an adverse effect on critical habitat for green sturgeon and salmonids.

Water Quality/Suspended Sediments

Several reports summarized dredged material behavior and sediment resuspension due to hopper and clamshell dredging and associated open water disposal (Palermo et al. 2009; LaSalle et al. 1991; Havis 1988; McLellan et al. 1989; Herbich and Brahme 1991; Truitt 1988).

Suspended sediment from the dredge operations is expected to occur, but suspended sediments and associated turbidity is expected to occur during dredging and dissipate quickly (within an hour or less) after dredging ceases. Dredging will occur only in deeper waters (-20 ft CRD). However, due to the large area and volume of initial dredging, we expect suspended sediment plumes to expand into shallower areas downstream of the CET prior to dissipation.
Material removed during maintenance dredging will be disposed of in-water in the Columbia River. Four potential disposal sites were identified and reviewed by the Portland District USACE during the Section 408 Agency Technical Review (ATR). Each of these sites is in deep water adjacent to the shipping channel.

Maintenance dredging would be conducted using a barge-mounted mechanical clamshell dredge with material loaded into a bottom-dump barge for in-water disposal. For in-water disposal, the operator would place the barge over the disposal area and open the bottom to release the material. Due to the draft of the barge, material would be released below the water surface.

A dredging and disposal quality control plan would be implemented in compliance with the dredged material management program as required by state agencies (Washington State Department of Ecology and Washington State Department of Natural Resources) and federal agencies (COE and U.S. Environmental Protection Agency).However, dredge disposal guidelines mandate dredge spoils be deposited within the flow lane of the Columbia River. As such, we expect dredge spoils discharge to create turbid plumes that dissipates mostly in the deepest part of the channel, but some suspended sediment is expected to reach shallow channel margins prior to dissipation to background levels.

Suspended sediment will also result from OGV traffic propeller movement, and wake erosion that results in continuous low level sediment inputs with episodic large inputs from bank failure (Mueller 1980, Hilton and Phillips 1982, Warrington 1999, Kahler et al. 2000, McConchie and Tolman 2003, and Graham and Cooke 2008). Pile installation will likely increase suspended sediment levels through the resuspension of sediment during construction.

The project-related suspended sediment increases will be localized and occur in a small portions of the lateral extent of the Columbia River, for a duration of three months during construction, and intermittently throughout the year during OGV moorage.

Water Quality/Stormwater

As discussed above, coal will be stored on site and exposed to weather. During precipitation events, stored coal can release polycyclic aromatic hydrocarbons (PAHs), a variety of toxic trace metals, and result in decreased pH levels of receiving water. Several studies, including Swift (1985), Cochran (1985, 1987), Morissey and Ahrens (2005), and Curran (2000), have concluded that runoff from stockpiled coal can harm fish and their habitat. Coal leachate runoff from the CET will be captured and treated onsite. Treated coal-contact water would then either be reused on-site or discharged to the Columbia River via an existing outfall.

MBT-Longview currently has an operating water treatment system that will be used to manage stormwater from the existing bulk terminal and other areas outside of the coal contact basin. The CET Project would obtain a separate NPDES permit and would develop a separate system of stormwater collection and discharge for the coal contact basin. Coal contact water, including all runoff from the coal stockpiles and from Docks 2 and 3 and the associated trestle would be captured and routed to the treatment facility, as would water used for dust control. The system for managing the CET's coal contact water has been designed to store and treat coal contact water on the site to the 100-year, 24-hour strom event. Above this threshold, stormwater would flood the stockpile areas for temporary storage and would not enter the Columbia River without treatment. The CET proposed coal-contact water treatment system consists of a multi-stage system. Simulated leachate studies, and leachate volumes from coal stockpiles were modeled to determine coal-contact water loads. Treatment would include solids removal and settling, aeration/oxidation, and coagulation/flocculation/precipitation. Once treated, coal contact water would either be used on-site or be routed to the site's existing stormwater treatment system for additional treatment post the CET treatment system. That sytsem would provide a second round of treatment consisting of a retention basin with oil skimmer and multi-meda filter plant. All effluent from the site would be treated to meet or exceed guidelines/standards established under the NPDES permit issued by Ecology. As a result, untreated coal leachate is not expected to be introduced into the Columbia River.

The CET's stormwater infrastructure would be designed to store and treat coal-contact water on site to the 100-year, 24 hour storm event, and any stormwater above this threshold would not enter the Columbia River without treatment. MBT-Longview currently has an operating water treatment system. However, the CET Project would obtain a separate NPDES permit and would develop a separate system of stormwater collection and discharge for the entire site footprint. Runoff from the upland portion of the site (including the coal stockpiles) and from Docks 2 and 3 and the associated trestle would be captured and routed to the treatment facility, as would water used for dust control. The majority of captured runoff would be reused onsite, with only a very small volume of treated discharge to the Columbia River expected to occur. The CET proposed coal-contact water treatment system consists of a multi-stage system. Simulated leachate studies, and leachate volumes from coal stockpiles were modelled to determine coal-contact water loads. Treatment would include solids removal and settling, aeration/oxidation, and coagulation/flocculation/precipitation. Coal contact water may also be routed to the site's existing stormwater treatment system consisting of a retention basin with oil skimmer and a multi-media filter plant for additional treatment post the CET treatment system. All effluent from the site would be treated to meet or exceed state and federal water quality guidelines/standards established under the NPDES permit issued by Ecology. As a result, untreated coal leachate is not expected to be introduced into the Columbia River.

However, to be conservative, we assume some amount of coal leachate could enter the Columbia River during stochastic events, such as temporary system failures, or multi-day rain events above the 100-year, 24 hour event. In this case, some unknown amount of coal leachate could enter the Columbia River assuming treatment capacity is surpassed by water volume or other unpredictable events occur. To this end, NMFS reviewed an analysis of the potential impact of CET discharge that enters the Columbia River. A model (HYDRUS-1D) was used to simulate leachate generated over varying saturated coal pile flows. The leachate volume generated during a 30-day period of intense rainfall under the simulated condition is 115,000 gallons, or 2.7 gallons per minute (gpm) for the 30-day period. The leachate volume and associated liquid to solids ratios were then used to predict the concentration and cumulative release of constituents if leachate were released to the Columbia River without additional treatment.

Although conservative, the leachate results were used in a Tier II Antidegradation Analysis for the CET Project. This approach is considered conservative because it is unlikely that coal leachate would be solely discharged without treatment, however in an evaluation to determine if water quality could be lowered due to the CET Project, the leachate data were used without further loading analysis. Based on the antidegradation analysis, there is not expected to be a measurable change in water quality outside the mixing zone for the proposed CET for conventional parameters (temperature, DO, bacteria, pH, and turbidity). For the toxic substances evaluated, only manganese shows a potential measurable change on water quality outside the acute, 31.6 foot mixing zone. Therefore, manganese was carried forward for specific treatment technologies in the AKART (all known, available and reasonable methods of prevention, control and treatment) analysis.

Similar to the anti-degradation evaluation, the leachate data were conservatively used to evaluate reasonable potential to exceed water quality values for both Washington and Oregon water quality standards. Parameters that show a reasonable potential to exceed water quality standards at the edge of the mixing zone for the proposed CET are aluminum and zinc. Aluminum, zinc, and manganese were carried forward from these analyses, and were the focus in the CET AKART evaluation.

An AKART analysis was completed to evaluate treatment technologies for the chemicals of concern (COCs) identified by performing a Tier II Antidegradation Eligibility Determination and a Reasonable Potential Analysis using results from the coal leachate study. Aluminum, manganese, and zinc were the COCs identified by these evaluations. Hydrogeologic and hydraulic modeling and loading estimates, including a coal pile leachate model, informed this effort. Treatment technologies were evaluated focusing on the COCs and the removal of solids. Recommended treatment includes solids removal/settling, aeration/oxidation and coagulation /flocculation/precipitation. Based on this analysis and considering the expected efficacy of treatment, impacts on critical habitat could occur during discrete events where water quality is affected. These events are expected to be rare. In the event of discharge of coal-contact water, the PBF for water quality would be adversely affected in the immediate area of discharge, and considering the large volume of the Columbia River, would be diluted to background levels within a few hundred feet or less.

While the risk of contaminants entering the Columbia River resulting from discrete events is minimized through proposed water management infrastructure, it does not completely preclude the risk of contaminants entering the aquatic system and affecting organisms, including ESA-listed fish. To assess the risk of uptake, bioaccumulation, and direct toxicological effects on ESA listed fish and their prey from coal leachate, NMFS evaluated a review of the relevant scientific literature provided by the applicant. The focus was on collecting data pertinent to the effect level concentrations of trace metals and PAHs that can be found in bulk coal. The lowest effect level threshold for each constituent was then compared to worst case conditions that could result from the discharge of CET coal-contact water via outfall 002A. This value was determined by applying the acute and chronic dilution factors used in the Tier II Antidegradation Evaluation. For outfall 002A, the dilution factors are 19 and 77 times for the analysis of acute mixing zone and chronic mixing zone effect level thresholds, respectively.

This effort did not yield any instances where untreated, diluted coal leachate would result in chronic conditions in the Columbia River that would adversely affect ESA listed species. These results are consistent with the additional analysis conducted by Anchor QEA for the proposed CET site, found in the NPDES permit application and presented in the Grette Associates memorandum dated August 2, 2018.

Coal contact water from the CET will undergo a multi-stage treatment process prior to discharge. As discussed above, the CET wastewater treatment system is designed to capture and treat 100 percent of coal-contact and other water prior to discharge in the Columbia River. The majority of particulate matter (and consequently most of the coal borne toxicants) will be removed during treatment. For example, Leppard et al. (1998) found that most of the water-borne PAHs in a coal impacted harbor were associated with suspended flocculants. When the particulate material was removed, dissolved PAH concentrations were decreased by 95%. Initial removal of solids from the CET coal contact water will occur in the CET Retention/Treatment Pond. Additional filtration to remove particulate matter will occur via aeration/oxidation and by passing the coal contact water through a coagulation/floculation/ precipitation unit.

Based on the results of the Antidegradation Analysis completed for the Project, the CET wastewater treatment system would be designed to target the removal of aluminum, manganese and zinc. However, the removal of solids and flocculants during the multi-stage treatment process is anticipated to yield similar reductions for other metals detected in coal leachate as well.

Once the coal-contact water is treated, it will either be comingled with non-coal contact stormwater collected at the site or reused on site for dust suppression, equipment washdown or fire system needs. Treated coal contact water slated for discharge to the Columbia River will be first comingled with non-coal contact stormwater from the CET.

Comingled non-coal contact stormwater from the CET and bulk terminal will be stored in a separate stormwater retention basin. Once comingled, the stormwater and post-treatment wastewater will undergo further treatment. The stormwater treatment system consists of additional solids and oil removal, via a separate stormwater settling basin and oil skimmer. From here, comingled water will pass through a multi-media filter plant. The mixed media filter system is made up of four identical closed filter units. Each unit includes 10-inches of high-density ilmenite, 9-inches of silica sand, 18-inches of anthracite coal. The combination of filter sand with high carbon content coal is a widely used dual-media filtration for city and industrial water purification.

Outfall 002A discharges water from the existing bulk terminal under an existing NPDES permit (Ecology 2018). Treated storm and wastewater from the proposed CET would be added to that discharge. The following additional analyses were conducted as part of the CET's NPDES permit application; 1) a Tier II anti-degradation analysis, 2) a designated use evaluation, and 3) a reasonable potential to exceed analysis. The goal of these three analyses were similar to the analysis completed herein; determine if effluent from the CET could create water quality conditions that would be injurious to aquatic species. Those analyses were conducted in accordance with the Clean Water Act and together with the draft AKART analysis determined that treatment options existed to achieve all applicable water quality standards.

The chronic effect level results support the analysis and conclusions presented in the draft Engineering Report and AKART Evaluation, Morrisey and Ahrens (2005) and in the BA, NEPA DEIS and SEPA FEIS prepared for the CET Project (Grette Associates 2017, IFC International 2016 and 2017). Toxic constituents are not easily leached from the coal sources to be shipped from the CET and would not lead to water quality impairment that would have an adverse effect on ESA critical habitat.

<u>Water Quality/Coal Dust</u>

Coal dust is common around the shipment and storage of raw coal. Coal dust can effect water quality both as a portion of total suspended solids (TSS), and as a potential pathway for injurious levels of toxicants reach the aquatic environment. At sufficient quantities, coal dust has similar adverse effects as elevated levels of suspended sediment on water quality. The CET will employ minimization measures to reduce coal dust on site. NMFS reviewed the worst-case analysis that estimates conservatively that 4.0 grams per square meter per month (g/m/month) will be deposited around the CET and in the Columbia River for the duration of the project. This value is above the benchmark of 2.0 g/m/month for the project, which was developed specifically for residential areas around the site (SEPA FEIS, 2017). As such, estimates using 4.0 g/m/month likely overestimate coal dust accumulation and potential effects.

Weather patterns are expected to greatly influence where coal dust settles, but it is also assumed that to create a relatively equal distribution of coal dust around adjacent areas of the CET. The mitigation area approximately 2,000 feet upriver from the CET site itself, and is expected to accumulate coal dust at about 0.1 to 0.01 g/m/month with minor variations related to wind direction. Using these and other assumption, the analysis predicted a maximum change in suspended sediment from dust to be less than 1 part per 10 billion (0.000075mg/L). Further, using the same data, if coal dust accumulated over the area for 120 days without being disturbed from precipitation, suspended sediment concentrations of up to 0/0192 mg/L could be possible (SEPA FEIS, 2017). This level of change in suspended sediment would not be detectable.

Studies have shown that coal dust contains trace amounts of a variety of contaminants including polycyclic aromatic hydrocarbons (PAHs), and several metals including lead, arsenic, cadmium, and others. NMFS reviewed an analysis of levels of these contaminants that could enter the water column around the CET site. All of the levels of contaminants in the aquatic environment derived from coal dust at the CET are magnitudes below EPA chronic values (Table 18) (USEPA, 2003).

Considering the low levels of contaminants and suspended sediment directly caused by coal dust, and because coal dust accumulates over time, and the majority of coal dust entering the Columbia River would be transported downriver before settling out, it is unlikely that coal dust in the water column would have detrimental effects on any PBFs of critical habitat.

Water Quality/Coal Spill

The proposed action includes the loading and shipping of coal at the CET. The trestle conveyor is enclosed. The conveyors have belt cleaning to control carry back. The dock is designed to contain all spillage and water that is returned back to the water management system. The shiploader boom would be enclosed to contain any spillage or hose-down clean-up work. The discharge of coal into the vessel is through an enclosed chute to allow discharge of the coal below the deck of the ship. The shiploader boom positions the chute in close proximity to the point of discharge. A spoon deflector allows the coal to be placed inside the hull below the deck of the vessel without additional handling. For these reasons, we do not consider a significant coal spill as reasonably certain to occur at the project site.

Trains will carry up to 44 million metric tons of coal through the state of Washington on an annual basis. We could not find information that evaluated the risk of a coal train spilling into the Columbia River or other tributaries. Nevertheless, in the event of a coal spill into the aquatic environment, effects would occur from the spill itself crashing into the water, the leachate of coal into the water column, and the disturbance from cleanup of the coal. Each of these elements carries levels of risk that differ depending on the time of year. If a spill were to happen into shallow water of the Columbia River during peak migration in May, direct effects on species and critical habitat could occur. These effects would include elevated contaminants as described above for coal-contact water, as well as disruption from disturbance related to coal entering the water and the subsequent removal using machinery below the OHWL. This would constitute a temporary adverse effect on the PBFs of migration and water quality.

Water Quality/Increased OGV Traffic

The completed CET would add significant rail traffic along the shores of the Columbia River that would not be there otherwise. Trains will carry up to 44 million metric tons of coal through the state of Washington on an annual basis. We could not find information that evaluated the risk of a coal train spilling into the Columbia River or other tributaries. Nevertheless, in the event of a coal spill into the aquatic environment, effects would occur from the spill itself crashing into the water, the leachate of coal into the water column, and the disturbance from cleanup of the coal. Each of these elements carries levels of risk that differ depending on the time of year. If a spill were to happen into shallow water of the Columbia River during peak migration in May, direct effects on species and critical habitat could occur. These effects would include elevated contaminants as described above for coal-contact water, as well as disruption from disturbance related to coal entering the water and the subsequent removal using machinery below the OHWL. This would constitute a temporary adverse effect on the PBFs of migration and water quality.

Water Quality/Heavy Equipment Operation

The use of heavy equipment during the proposed construction activities creates the opportunity for accidental spills of fuel, lubricants, hydraulic fluid, and other petroleum products, which, if spilled in the vicinity of the action area, could injure or kill aquatic organisms (Asplund 2000), as described above. The proposed conservation measures, such as implementing a spill containment plan, will minimize the risk of significant contaminant releases during in-water work. Based on the conservation measures, it is highly unlikely that there will be an adverse effect on critical habitat from contaminants during the in-water work construction.

Water Quality/Mitigation Site Construction

Construction of the aquatic habitat mitigation site will occur in an area disconnected from the river. Significant grading and filling will occur. Upon breaching the berm to allow Columbia River water to inundated the site, suspended sediment is expected to occur, and would likely move out of the mitigation area and into the Columbia River. Because inundation would occur when the tidal height of the Columbia River is near or below the breach area, we expect inundation to be relatively gradual. Further, although we expect suspended sediment emanating from the newly-inundated mitigation area to enter the Columbia River, it will not be of the intensity or duration to have adverse effects on critical habitat.

Safe Migration

Shade, together with the overwater structures that cause the shade, also function as obstacles to migration when they are placed in the migratory pathway of salmonids. Structures and shade delay migration, increase the migratory route of juvenile salmonids, and increase the vulnerability of juvenile salmonids to predators. Therefore, increase in shade and structure from the CET will result in an adverse effect to designated critical habitat for Columbia River salmonids

Overall Effect on PBFs of Salmonid Critical Habitat

1. ***Freshwater Spawning.*** There is no known spawning habitat within the project area in the Columbia River.
2. ***Freshwater Rearing.***
    a. Floodplain connectivity. Several studies have cited long period wake waves caused by OGV traffic and other vessels as a source of bank erosion in rivers and

other waterways (Long, 2007, McConchie and Toleman, 2003, Laderoute and Bauer, 2013, Cameron and Bauer, 2014). Propeller wash from ships in transit, as well as wakes breaking on shore, can cause erosion along unarmored sections of shoreline. This has the potential to result in degradation of habitat suitability along the Lower Columbia corridor. Changes or disruptions to riparian areas can threaten the survival of species that rely on this kind of habitat during their various life stages. They depend on these areas for breeding, spawning, nesting, feeding, growing and escaping from predators. The proposed 7-acre off-channel mitigation site will improve floodplain connectivity PBF at the immediate project site.

b. <u>Water quality</u>. Turbidity concentrations will increase during project activities (months). Over the long term, there will be small increased potential for toxic contamination (*i.e.* coal-contact water, fuel, oil, lubricants) of the aquatic and substrate environments and turbidity from increased OGV traffic. The present temperature of the Columbia River will be maintained.
c. <u>Water quantity</u>. No effect.
d. <u>Forage</u>. Temporary decreased forage quantity and quality due to increased suspended sediment and dredging. Small, but long-term reduction of forage due to contaminants from increased ship traffic, and loss of substrate from installation of piles. Long-term effects on forage from new overwater structure are intended to be offset by the Off-Channel Slough Mitigation Site.
e. <u>Natural cover</u>. The Project area is currently devoid of natural cover. The off-channel mitigation site is intended to result in improved conditions for natural cover with the addition of native plantings that will overhang in the mitigation aquatic area.

3. ***Freshwater Migration Corridors.***
    a. <u>Free passage</u>. Upstream and downstream migration will be disrupted and delayed during pile driving, and will continue with the presence of the CET and increased ship traffic.
    b. <u>Water quality</u>. Same effects on water quality as described for freshwater rearing sites.
    c. <u>Water quantity</u>. No effect.
    d. <u>Natural cover</u>. Because erosion typically precedes bank armoring, we assume the operation of the CET Longview facility will indirectly affect nearshore habitat processes in a way that will promote bank armoring into the future for protection of property. Hardening of shorelines removes existing off channel habitat or precludes the formation of off channel habitat that is important juvenile salmon rearing habitat. As such, we expect some amount of erosion of riparian salmonid habitat, particularly for ocean-type juveniles from the Lower Columbia River that rear in shallow, nearshore margins of the Columbia River. Bank armor designs that include large wood extending into the channel and riparian planting in the armor minimize reduce the adverse effects of the armor

4. ***Estuarine Areas.***
    a. Forage. Similar to effects on forage at freshwater rearing sites. Long-term effects on forage from new overwater structure are intended to be offset by the Off-Channel Slough Mitigation Site, resulting in improved conditions for this PBF.
    b. Free passage. Similar to effects on free passage in freshwater migration corridors.
    c. Natural cover. No effect.
    d. Salinity. No effect.
    e. Water quality. Same effects on water quality as described for freshwater rearing sites.
    f. Water quantity. No effect.
5. ***Nearshore Marine Areas.*** None designated.
6. ***Offshore Marine Areas.*** None designated.

Overall Effect on Critical Habitat of Eulachon.

1. ***Freshwater Spawning***
    a. Water flow. Spawning is not known to occur in the vicinity of the proposed structure. If eulachon spawning were to occur near the structure, water flow will be minimally affected in the nearshore area.
    b. Water quality. Over the long term, there will be small increased potential for toxic contamination (*i.e.* fuel, oil, lubricants) of the aquatic and substrate environments from increased ship traffic.
    c. Water temperature. No effect.
    d. Substrate. Over the long term, there will be small increased potential for toxic contamination (*i.e.* fuel, oil, lubricants) of the aquatic and substrate environments from increased ship traffic and coal leachate runoff.
2. ***Freshwater Migration***
    a. Migratory corridor. Upstream and downstream migration will be temporarily disrupted and delayed due to pile driving. The elevated orientation of the trestle structure should not restrict access to this area for migration. Larval eulachon migrate through the LCR as passive drift the proposed action and will not be affected in their downstream migration.
    b. Water flow. No effect.
    c. Water quality. Similar to water quality impacts at freshwater spawning sites.
    d. Water temperature. No effect.
    e. Food. No effect.

The effects of the proposed action are likely to have an adverse impact on PBF conditions that eulachon need for water quality and substrate in freshwater spawning areas, and for water quality, migratory corridors, in freshwater migration areas. Due to the temporary nature of construction of the project, the adverse impacts of the proposed action on PBFs are not expected to cause a permanent reduction in the conservation value of any of the critical habitat considered here.

<u>Overall Effect on Critical Habitat of proposed Humpback Whale Critical Habitat</u>

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a. Forage. Anthropogenic noise from OGVs in Humbpack Whale Critical Habitat will disturb whales while foraging, decreasing success.
b. Free Passage: Anthropogenic noise from OGV's will delay migration, noise will also disrupt whale to whale communication, which can affect migration in Humpback Whale proposed critical habitat.

<u>Leatherback Sea Turtle</u>.

NMFS does not anticipate effects on the PBFs of prey species or other feature of critical habitat for leatherback sea turtles from the proposed project. This included the consideration of direct effects and indirect effects to prey species, such as an increase in contaminants from OGV transit. As a result, designated critical habitat for leatherback sea turtles will not suffer adverse effects from the proposed action.

<u>2.4.2 Effects on Species</u>

Salmon, Steelhead, Green Sturgeon, and Eulachon

The proposed action will affect ESA-listed fish species considered in this opinion by causing physical, chemical, and biological changes to the environment (described above), and through direct effects to individual fish. Fishes will be exposed to reductions in water quality from increased suspended sediment and contaminants, reduced prey base in their habitats, and migratory pathway obstructions, as well as hydroacoustic impacts, ship wake stranding, and harassment/displacement from in-water disturbances.

<u>Pile Driving and Barotrauma</u>. The project would require the installation of 531, 36-inch steel piles to support Docks 2 and 3 and their associated trestle. Piles will be installed with both vibratory and impact methods. All impact pile work will be conducted during the September 1 through December 31 pile driving work window. All piles will initially be installed via vibratory hammer, followed by proofing with an impact hammer with sound attenuation strategies including the use of bubble curtains. The project will utilize two pile drivers to expedite work. Acoustic disturbances associated with pile driving are likely to disrupt the foraging behavior and reduce forage efficiency of juvenile salmonids. Biological effects to ESA-listed salmonids may also result from the high sound pressures produced when the piles are proofed with an impact hammer. These biological effects could be exacerbated if two pile drivers are impact driving simultaneously where high sound pressures from each impacted pile overlap with each other in a given area between them. This exacerbation can be reduced by minimizing the distance between piles being driven (Stadler, pers comm 5-18-19).

Fishes with swimbladders (including salmonids) are sensitive to underwater impulsive sounds, i.e., sounds with a sharp sound pressure peak occurring in a short interval of time (Caltrans 2001). As the pressure wave passes through a fish, the swimbladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under pressure component of the wave passes through the fish. The pneumatic pounding may rupture capillaries in the internal organs as indicated by observed blood in the abdominal cavity, and maceration of the kidney tissues (Caltrans 2001). The injuries caused by such pressure waves are known as barotraumas, and include hemorrhage and rupture of internal organs, as described above, and damage to the auditory system. Death can be instantaneous, can occur within minutes after exposure, or can occur several days later. A multi-agency work group determined that to protect listed species, sound pressure waves should be within a single strike threshold of 206 decibels (dB), and for cumulative strikes either 187 dB sound exposure level (SEL) where fish are larger than 2 grams or 183 dB SEL where fish are smaller than 2 grams. The SEL measurement is a cumulative measurement, based on the number of consecutive strikes, where the SEL increases as pile strikes increase in number. When many consecutive pile strikes are needed, Stadler (pers comm 5-18-19) states that cessation of pile driving for 10-12 hours after multiple strikes before resuming pile driving reduces SELs to baseline and can provide fish an opportunity to move through the area and away from the impacted pile, reducing effects of SELs on fish. Based on information provided in the Biological Assessment, we estimate a cumulative SEL at approximately 228 dB based on 15,000 strikes per day. This dB could increase if more than 15,000 strikes occur in one day. As such, death or injury of individual fish is likely to occur.

The number of blow counts is expected to be highly variable from day to day and dependent largely on the equipment used and geologic conditions encountered in a given area. However, assuming two pile driving rigs are operating over an entire work day, it is possible but not likely that construction activities could generate up to 50,000 impact pile strikes per day. However, pile strikes will be disrupted for 20 minutes to an hour after each pile is driven in order to set up for a new pile and deploy the bubble curtain or other sound attenuating device.. This would minimize simultaneous pile driving. A typical pile driving day would be approximately 15,000 strikes. Estimates for minimum, typical and maximum impact strikes per day are presented in Table 11.

Deployment of a bubble curtain is expected to attenuate the peak sound pressure levels by approximately 7-9 dB. As such, a bubble curtain may not bring the sound pressure levels below biological thresholds, and some death or injuries of ESA-listed salmonids are still likely to occur. Even with the use of the bubble curtain, adverse effects to salmonids are expected in the vicinity of the pile driving. Yelverton et al. (1975) found a direct correlation between smaller body mass and the magnitude of injuries and mortalities from underwater blasts. The September through December pile driving work window greatly minimizes the likelihood that small juvenile (Year 0) fish to be present; larger juvenile and adult fish for some ESU/DPS may be present.

Table 11. Possible range of daily impact pile driving for the CET Project.

	No. of pile per day	No. of impact strikes per day
Minimum	2	2,000
Typical	6	15,000
Maximum	Up to 50	Up to 50,000

General assumptions used to arrive at these estimates include:

1. The CET project would require installation of 531 36-inch steel pile to support Dock 2 and 3 and their associated trestle, including 6 trestle pile in adjacent uplands.
2. A vibratory hammer will be used to advance the piles to practical refusal prior to impact driving.

3. To accomplish impact pile driving during the limited in-water work window, two impact pile-driving rigs are expected to be operated simultaneously.
4. Each pile will be embedded approximately 20 feet into the dense sand and/or gravel layer to develop the required axial capacity.
5. Each pile will require between 20 and 120 minutes of impact pile driving to install[3].
6. Each pile would require between 930 and 4,030 impact strikes to install[3].
7. Impact pile driving will be completed over the course of two in-water construction seasons.

Based on conservative estimates of sound exposure level, number of pile strikes per day and sound attenuation of 7dB, injury to juvenile listed salmonids could occur up to 8,241 feet from the pile driving. There may also be effects to salmonid behavior due to underwater noise up to 3.92 miles upstream and downstream from the pile driving. The applicant proposes to reduce the effects of impact hammer use by timing the activity when fish densities are lowest, particularly for subyearling juvenile salmonids, and using a vibratory hammer to the greatest extent possible.

Installing steel piles with impact hammers and vibratory hammers will cause interruption of essential behaviors for four months each year, and is likely to injure or kill some individuals. Pile driving with two drivers simultaneously is more likely to injure or kill individuals that enter the area of overlapping elevated sound. The pile driving work will avoid and/or minimize impact pile driving during peak migration times for most adult and juvenile fish (salmon, steelhead, eulachon, and green sturgeon) through the action, but some fish (various life stages) for many ESUs/DPSs may be present in the action area during this time. Because of the large amount of pile driving required (531 piles), and the large area of potentially injurious sound, in order to be conservative in analysis and therefore protective of the species, we expect individual fish from all populations could be affected. Fish holding in the vicinity of impact pile driving are likely to be injured or killed; however most juveniles and all adult fish are not expected to be holding in the vicinity of the pile driving. Rather, they are expected to be migrating through the action area and only a portion of the action area will be affected by noise. As such, we expect that the effects of pile installation could injure or kill a few individual fish each day during pile driving and a few hundred among those present and exposed to this noise over the two pile driving seasons.

The sound pressure waves from vibratory pile driving are much shallower and do not result in physical injury. Vibratory hammers produce sound pressure levels approximately 17 dB below those produced by impact hammers (Nedwell and Edwards 2002), and injurious effects from vibratory pile driving have not been reported from any empirical study of which the NMFS is aware. Based on this, the direct effects of sounds from vibratory pile driving would not cause injury to fish.

Behavioral Response to Pile Driving

Pile driving may have some effects on fish behavior. These effects have been studied for salmonids. In a field study, Grette (1985) investigated the impacts of steel sheet pile driving on adult salmonid runs (Chinook, coho , and sockeye) through the Hiram H. Chittenden Locks in

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[3] Project engineers have estimated strike count and durations for shallow- and deep-resistance scenarios based on site conditions (GRI 2012 and 2013; as cited in the Pile Driving Appendix to the BA).

Seattle, Washington. The study found that daily patterns of migration through the locks were similar during periods of pile driving, and during periods when no pile driving occurred. The study concluded that pile driving did not influence the number of salmon ascending the fish ladder within the locks.

Feist et al. (1996) observed the behavior of juvenile pink (*O. gorbuscha*) and coho during wharf construction at Everett Homeport in the Snohomish estuary. Concrete piles were driven with impact hammers using two pile driving rigs that operated for 8-10 hour periods per day for three days during the week. The study found subtle effects and possible changes in fish behavior. On days when pile driving was not occurring, the fish exhibited a more polarized schooling behavior (moving in a definite pattern). Fish appeared to change their distributions about the site, orienting and moving towards an acoustically-isolated cove side of the site on pile driving days more than on non-pile driving days. It was also noted that the prevalence of fish schools did not change significantly with and without pile driving. Fish were feeding well the day they were sampled around the rigs and along the shore. Feist et al. (1996) concluded that the study could not demonstrate whether pile driving had a detrimental effect on the fitness of juvenile pink and chum salmon.

Ruggerone et al (2008) placed juvenile coho salmon in cages between 6 and 45 feet from 14 steel piles while exposing them to 1,627 strikes during a 4.3-hour period. Only one fish showed an avoidance response and no fish exhibited a fright response. Startle responses of a small portion of total fish were observed in only 4 of 14 first strikes and they tended to occur when cages were close to the piles and sound pressure levels were relatively high. Visual stimuli, such as a contractor walking by a cage, caused a greater startle response. No external or internal injuries associated with pile driving sounds were observed. Behavioral responses of salmon to pile strikes were subtle. The report concluded that the coho salmon were not significantly affected by cumulative exposure to pile driving sounds produced in that study (Ruggerone et al. 2008).

Although numerous studies have attempted to discern behavior effects to different type of fish species from elevated sound levels that are below harm levels but above ambient levels, relatively few papers have linked this exposure to effects on fish (Popper et al. 2014). Under some conditions, with some species, elevated sound may cause an effect but it is not possible to extrapolate to other conditions and other species (Popper and Hastings 2009). Davidson et al. (2009) indicated that studies have shown that salmonids do not have a wide hearing bandwidth or hearing sensitivity to sound pressure levels and are therefore not as likely to be impacted by increased ambient sound. Because sound pressure levels increase cumulatively with the number of pile strikes, a fifteen minute break after every 1000 strikes or so can be an effective way to reduce SELs and subsequent effects on fish (J. Stadler, pers comm, 2-2-19). Cessation of pile strikes for 15 minutes between consecutive strikes can allow fish to move through and away from the area, and reduces the overall time pile driving reaches levels above the 187/184 dB threshold where SELs can be injurious to fish.

Based on these studies, NMFS expects that some salmonids may react to elevated sound levels by avoiding the area during construction or by change in schooling behavior but we do not expect the effects to be detrimental. Further, because of timing of pile driving is not expected to overlap with migration timing of eulachon. Green sturgeon are unlikely to occupy the area where

SELs would be harmful (Hansel, et al, 2017); however, if green sturgeon were to be within the elevated SEL area, they would leave the area. As such, we do not expect effects on eulachon and green sturgeon to be detrimental.

Response to Pier Shading /Reduced Prey Abundance

Shade can typically reduce juvenile salmonid prey organism abundance by reducing aquatic vegetation and phytoplankton abundance (Kahler et al., 2000, Carrasquero 2001). Glasby (1999) found that epibiotic assemblages on pier pilings subject to shading were markedly different than in surrounding areas. There is no submerged aquatic vegetation in this reach of the river, most likely due to the dynamic nature of the system and the high water velocities. The structure and composition of benthic organisms are constantly in a state of change in this reach of the Columbia River, due to the sand waves that naturally form and propagate along the river bottom. These sand waves move organisms down the river channel as they form and reform. New piles may eliminate substrate available to benthic aquatic organisms and therefore, eliminate a possible food source for juvenile salmonids and eulachon larvae and juveniles in the project area. Green sturgeon are unlikely to use the area around the CET (Hansel et al, 2017). Based on an initial review of the life history information in the proposed CFR listing (NOAA 2005b), 2002 NMFS Status Review (Adams et al. 2002), 2005 NMFS Status Review Update (NOAA 2005c), and as summarized in the most recent annual report produced by Oregon Department of Fish and Wildlife (Farr and Kern 2005), these fish may be present in the lower river but do not spawn and are extremely unlikely to forage. There is evidence that little if any feeding occurs in the lower Columbia River (Farr and Kern). Placement of piles and associated structures has also been shown to provide foraging habitat, and may partially compensate for loss of benthic productivity. Carrasquero (2001) states that juvenile salmonids will feed upon periphyton, insects, and macroinvertebrates adhered to dock and pier pilings in the Columbia River. We would expect that eulachon larvae and juveniles could also utilize this food source. Adults do not feed during spawning (NMFS 2011i). Shading from the proposed structure and loss of benthic productivity from placement of piles will result in a slight reduction of food sources in the project area. This effect will be small when the extent of available habitat in the Lower Columbia River is taken into consideration, as forage sources will remain available in habitat surrounding the project area.

The proposed dredging will reduce food production in an approximate 41.5 acre dredge prism area by disturbing benthic habitat and benthic productivity. Available forage from sources outside of the action area will remain at current levels. Benthic invertebrates provide the primary food source for ESA-listed fish – dominated by families of midges (Johnson et al. 2011). The aquatic invertebrates occupy the upper surface of the river bottom with a life cycle of many weeks to months before emerging into the water column. The level and nature of the disturbance is not unlike natural processes that continually move river bottom sediments, burying or eroding benthic habitat. Recolonization of the benthic habitat is rapid – within weeks to months (McCabe et al. 1998). As such, we expect loss of forage in the dredge prism to recover prior to the following spring when the majority of juvenile salmonids are transiting the dredge and CET area. Further, as discussed above, the dredge area represents a small fraction of available benthic habitat in the Columbia River at this location. Because of the reasons discussed above, temporary, episodic loss of benthic forage from the 41.5 acre dredge prism will have minor and temporary effects on individual juvenile fish.

Response to Increased Predation/Reduction in Safe Passage

Avian Predation. Over water structures could provide perching platforms for avian predators. Piscivorous birds that have been shown to feed on juvenile salmon include double-crested cormorants, Caspian terns, several species of gulls and American white pelicans. (Evans et al. 2012). Birds tend to congregate where prey is abundant. Upstream of Bonneville Dam, predation by birds (particularly terns and cormorants) can be substantial, but predation in the lower Columbia River is generally very low (Evans et al. 2012).

The surface of the proposed dock will be elevated above +20 ft CRD. Kahler et al. (2000) noted that double-crested cormorants and gulls in Lake Washington typically perch on the log booms or single piles rather than on docks and bulkheads. Pelicans are unlikely to use the proposed dock for perching as they generally are clumsy on the ground and hunt from the air or swimming on the surface. Similar to pelicans, terns are less likely to use the structure for perching because when they forage, they fly high over the water, hover, and then plunge to catch fish below surface. In addition, the high amount of human activity on the industrial pier would dissuade bird activity. Docks 2 and 3 and their associated trestle will incorporate pile caps as appropriate to reduce potential for avian predation. Further, considering the locations of tern and cormorant colonies it the lower Columbia River and typical distances over which these birds travel during foraging, the action area is not expected to be utilized by foraging cormorants or terns. Therefore, we do not expect the new pier structure to result in an increase avian predation, as such, avian predation is not expected to affect fish.

Piscivorous Fish Predation. While the project design minimizes nearshore shading by placing the majority of overwater structure in deeper water, the trestle leading to the main terminal is a solid platform construction. Such overwater structures can increase predatory opportunity for fish that eat salmonids, as salmonids cannot view predators as well in shaded environments. In addition, the pile structures can slow the velocity of the water to become more conducive for predator use. Carrasquero (2001), in reviewing the literature regarding impacts of overwater structures, reported that smallmouth and largemouth bass have a strong affinity to structures; forage and spawn in the vicinity of docks, piers and pilings; and, largemouth and smallmouth bass are common predators of juvenile salmonids. Pribyl et al. (2005), in studies on piscivorous fish in the lower Willamette River found that smallmouth bass were found near beaches and rock outcrops more frequently in the winter and spring, and highly associated with piles regardless of the season. For largemouth bass, they found that they were found near piles and beach sites in summer and autumn and near piles, rock and beach areas during winter and spring. They also indicated that large sized predators were present at very low densities, but juveniles were fairly abundant.

Tabor et al. (2004) observed predation of salmon by three types of fish in secondary and primary pools in the Cedar River but did not detect predation in faster moving waters in shoreline areas or in mid-channel riffles. Stuber et al., (1982) found that when river velocities are greater than 0.65 feet per second (fps) largemouth bass are unlikely to use the area. Martinelli and Shively

(1997) found that pikeminnow in the CR in all studied locations studied were found used in water velocities of less than 3.3 fps in 99 percent of the observations. Faler et al. (1988) monitored the movements of 23 pikeminnows below McMary Dam and found them to use habitats with velocities ranging from 0 to .02 feet per second. They noted that pikeminnows avoided areas of high current velocity, as they were less likely to move into the tailrace when water velocities exceeded 3.3 feet per second (fps). Tabor et al. (1993), is one of the few studies that investigated smallmouth bass in the Columbia River (McNary reservoir) and, like pikeminnow, found smallmouth bass preferring slow-velocity habitats similar to pikeminnow. The action area (before construction) has current velocities within the range suitable for pikeminnow (0 to 3 fps). Following construction, we expect piles to further slow velocities in the project area, creating more opportunity for pikeminnow and bass predation.

Although overwater shading can cause an increase in predation, numerous studies have indicated that a large portion of seaward juvenile salmon migration takes place at night when shading effects would not be an issue (Meehan and Siniff 1962; McDonald 1960; Mains and Smith 1964; Lister et al. 1971; Volobuyev 1984; Kobayashi and Ishikawa 1964; Hunter 1959; Koski 1975 as cited in Groot and Margolis 1991). Chapman et al. (2012) stated that smolts may time their migration to nighttime hours to optimize their chance of completing migration to the ocean and lower their risk of predation. Nevertheless, we expect predation to occur on juveniles salmonids for the life of the project.

The trestle will extend a total 842 feet waterward from the OHWM, with approximately 13,400 sf of new overwater structure in the nearshore portion of the action area for the life of the structure. Because of the relative permanence of the structure in the action area, migrating juvenile salmonids will encounter the structure for the foreseeable future. Juvenile salmonids that encounter overwater structure typically respond by swimming around it (Kemp *et al.* 2005). Swimming around the new overwater structure lengthens their migratory pathway and forces juveniles into deeper waters thus increasing predation risk. Even minor adjustments to the migration route can be adverse, as it increases energetic expenditure, and encounter time with predators (Peterson and DeAngelis, 2000). Additionally, as described in more detail below, increased expression of energy can increase vulnerability to piscivorous predators and has been shown to be correlated with juvenile mortality (Anderson *et al.* 2005). Rearing juveniles also experience diminished habitat condition as the structure and shade reduced forage opportunity and displace the smaller juveniles from shallow rearing areas. Thus, to the extent in-water and overwater structures will modify migratory and rearing habitat for a period of decades, these structures will reduce the quality of the migratory corridor and the rearing habitat to some degree.

As mentioned above, in addition to the increased expression of energy that can accompany juvenile migration around structures that cross the shoreline into the water, the in-water and overwater structures will create areas of cover that slow water velocity and shade the water column. Both enhance habitat for the piscivorous northern pikeminnow, a known predator of out-migrating ESA listed salmon smolts.

Predation of Salmonids by Pikeminnow

As we did not find literature reporting on predation effects associated with docks within the LCR, we assume that results from other areas of the Columbia River and laboratory studies provide a reasonable surrogate for the interpretation of predation related effects. In the Columbia River, outmigrating juvenile salmon are a seasonally important part of the diet of piscivorous predators including northern pikeminnow. Historically, pikeminnow accounted for 78 percent of total salmonid losses to piscivorous predation (Rieman *et al.*, 1991). In nearshore areas of the Columbia River, including four sampling sites below Bonneville dam, more than 84 percent of fish consumed by northern pikeminnow were juvenile salmonids, regardless of river reach and season (Zimmerman and Ward, 1999).

To determine the extent to which the proposed action will increase predation opportunity, and predict the extent to which predation will increased under the proposed action, NMFS used published, peer-reviewed and technical reports of field and laboratory studies to create a deterministic model (based on arithmetic relationships) that calculates the number of smolts expected to be consumed in the area the trestle will occupy in pre and post construction conditions. Pikeminnow predation predictions (expressed as a total number of smolts consumed) were generated using long-term (17 year) average abundance estimates, published, average consumption rates in proximity to the action area, and an exponential decay function which estimates the predation success of pikeminnow under varying light intensities. The conceptual model including equations, supporting material, calculations, and key assumptions are detailed in Appendix 2. Because only the trestle section of the proposed project will be over water less than 20 feet in depth where juvenile salmonids primarily occur, we expect the majority of predation to occur there. As such, this analysis only predicts predation by pikeminnow associated with the trestle, although we assume similar predatory responses are occurring with other piscivorous predators utilizing the overwater structure including smallmouth and largemouth bass. Thus the model estimates are likely an underestimate of enhanced predation due to the proposed action.

We quantified the additional predation likely to occur from enhanced predator habitat under the structure caused by shading effects. Because the consumption rate of pikeminnow increases with decreasing light intensity (Petersen and Gadomski 1994), we varied the amount of light under the dock utilizing the percentage of light penetrating surface area of the over water structure. The trestle structure would be about 8 feet above the surface of the water, allowing light transference depending on the position of the sun and its aspect to the trestle. Therefore, we assumed approximately 25 percent of light would reach the water's surface, which is about 75 percent less than without the proposed overwater structure.

The reduction in light reaching the water's surface will affect the amount of light penetration at depth where piscivorous predators and juvenile salmon interact. Lower light intensity conditions increase the consumption rate of pikeminnow (Petersen and Gadomski, 1994), thus we can expect more juveniles to be eaten by pikeminnow using the new overwater structure. This difference in consumption rate (number of juveniles/pikeminnow/day) multiplied out over the juvenile outmigration period is the number of extra juvenile salmon predated due to the enhancement of predatory habitat due to shading. Results of the model are presented in Table 3. Due to the enhanced predatory conditions under the overwater structure, we estimated that 3 additional juveniles (rounded to the nearest whole fish) will be consumed by pikeminnow per year. Light penetration is the most sensitive variable with respect to estimated predation (See Appendix A, Table A2), because of this sensitivity, we've presented alternative estimates of predation for the overwater structure in comparison to the proposed action's amount of light penetration in Table 12. The increased consumption per year of juvenile salmonids due to light penetration scenarios ranges from 8-200 (average = 104) for the new structure. Additional scenarios which vary density and consumption rates of pikeminnow, in addition to light intensity can be found in Appendix A.

Table 12. Results predicting northern pikeminnow predation associated with the trestle for the proposed action, and alternative scenarios which vary the amount of light penetration. This table includes rounding errors as consumption estimates were rounded to the nearest whole fish.

Scen-ario	Square Feet	Light Penetr a-tion	Den -sity	Pike-minnow Consump t ion of juvenile salmon Without Structur e	Pike-minnow Consumpt ion of juvenile salmon Without Structure	Pike-minnow Consump t ion of Juvenile Salmon With Structure	Pike-minnow Consumpt ion of Juvenile Salmon With Structure	Pike-minnow Consumpt ion of Juvenile Salmon Difference	Pike-minnow Consumpt ion of Juvenile Salmon Difference
				1 Year	40 Years	1 Year	40 Years	1 Year	40 Years
Propos ed Action	13,400	25%	4.6 4	174	6952	289	11544	115	4593
Less Light	13,400	10%	4.6 4	174	6952	374	14,949	200	7998
More Light	13,400	90%	4.6 4	174	6952	182	7279	8	328

In nearshore areas of the Columbia River, including four sampling sites below Bonneville dam, more than 84 percent of fish consumed by northern pikeminnow were juvenile salmonids, regardless of river reach and season (Zimmerman and Ward, 1999).

Adult salmonids, even those returning to spawn after only 1 year in the ocean, are too large to be consumed by piscine predators that may utilize in-water and overwater structures associated with the proposed action. Therefore, we do not expect injury or death among adult fish from this habitat alteration. Adult salmonids tend to be more mid-channel oriented and migrate in deeper waters. Thus, the frequency that adults will encounter the structure and likelihood for adverse effects is low. We expect adult salmonids that do encounter the main float and finger pier structure will swim around and/or underneath the structure with little or no variation in migratory pathway. To the extent in-water and overwater structures will modify critical habitat for a period of decades, the presence of in-water and overwater structure will only slightly reduce the quality of the migratory corridor for adult salmonids. Placement of the landing and dock in deeper water, farther from the shoreline, will maintain a migration corridor on either side of the structure.

While there will be an increase in predation on juvenile salmonids, we expect the number to be somewhat distributed across the salmonid species, the bulk of predation will occur among the smaller (sub-yearling migrant) fish as they rear or transit through the action area.

Although the applicant has designed the terminal to minimize effects on ESA-listed species by moving the greatest part of the structure into deeper water away from nearshore juvenile migration, the solid platform trestle over nearshore habitats will increase shading and will increase the chance of predation on juvenile salmonids by predatory fish. Smaller, nearshore dependent salmon in this area such as LCR Chinook, LCR coho, UWR Chinook, and CR chum are the most likely to be affected by predation resulting from the over water coverage. As such, we expect that the effects of the nearshore over water trestle will result in injury or death of individuals each year the structure is in existence.

Predation of Eulachon

Eulachon are very high in lipids, and their historical large spawning runs made them an important part of the Pacific coastal food web. They have numerous avian predators, including sea birds such as harlequin ducks, pigeon guillemots, common murres, mergansers, cormorants, gulls, and eagle (NMFS 2011i)s. Fish that prey on eulachon include white sturgeon, spiny dogfish, sablefish, salmon sharks, arrowtooth flounder, Pacific hake, salmon, Dolly Varden, Pacific halibut, and Pacific cod (NMFS 2011i). Eulachon and their eggs seem to provide a significant food source for white sturgeon in the Columbia and Fraser rivers (NMFS 2011i).

In years of great abundance, large numbers of eulachon may return to the CR. Some of these individuals will migrate through the action area to access spawning sites in nearby watersheds such as the Cowlitz, Lewis, and Kalama rivers as well as along beaches up to Bonneville Dam. Therefore, some adult eulachon, including their eggs and larvae will be exposed to permanent habitat effects of the action. Migration of juvenile eulachon begins as passive drift by eggs and larvae, so the presence of additional structures will not alter their migration behaviors. To the degree that additional structures create advantageous habitat for additional predacious fish, there could be an increase in predation of larval eulachon.

Adult eulachon are likely to respond to permanent habitat effects similarly to adult salmonids, by a slight adjustment in their migration pathway. Adult eulachon are typically 6-8 inches in length (NMFS 2017a), which is beyond the gape limit of all but the largest piscine predators in the LCR. Thus, we do not anticipate adult eulachon to be subjected to increased predation as the result of the action.

Response to Decreased Water Quality

Suspended Sediment. Initial and maintenance dredging and dredge disposal will create suspended sediment plumes that will affect listed species. As described more fully below, elevated suspended sediment levels affect ESA-listed species in many ways, including: (1) reduction in feeding rates and growth, (2) physical injury, (3) physiological stress, (4) behavioral avoidance, (5) delayed migration, and (6) reduction in macroinvertebrate populations. Suspended sediment is expected during initial and maintenance dredge operations, as well as open-water disposal during maintenance dredging.

Laboratory studies have consistently found that the 96- hour median lethal concentration (LC50) for juvenile salmonids is above 1,097 mg/L for 1 to 3 hour exposure (Newcombe and Jensen 1996). Based on an evaluation of seven clamshell dredge operations in fine silt or clay substrates, LaSalle (1988) determined that the upper limit in suspended sediment levels was 700 mg/l and 1,100 mg/l at the surface and bottom of the water column, respectively (within approximately 300 feet downstream of the point of the operation). Much lower concentrations (50 to 150mg/l at 150 feet) are expected at sites with coarser sediment such as the project location. Since the sediment in the Columbia River is primarily sand, it has a settling velocity in the range of 0.03 to 0.06 feet per second (redeposits in approximately 1 to 2 minutes).

Suspended sediment from the dredge operations is expected to occur, dissipating as the sediment is carried downstream to the point of the background level approximately 300 feet downstream. This expected plume is limited in time and spatial extent because suspended sediments and associated turbidity expected to occur during dredging dissipate quickly (within an hour or less) after dredging ceases. Dredging will occur only in deeper waters (-20 ft CRD), and will occur from August 31 through December 31. We expect some young-of-the-year LCR Chinook salmonids to still be present during dredging, albeit in small number. Young of the year salmonids are oriented towards the shallow river margins. Because the initial dredge area and volume is large (41.5 acres, 350,000 cy), we expect suspended sediment to reach the river margins prior dissipation. Dredge disposal for the initial 41.5 acre dredge will be disposed of at Ross Island. We expect open-water disposal of materials moved during the maintenance dredging program to reach river margins prior to dissipation to background levels. Most salmonids that are present in the areas affected with elevated suspended sediment would be larger, upriver or stream-type stocks that are expected to be of sufficient size to enable their avoidance of waters affected by excessive suspended sediments. Thus, exposure of stream-type salmon, steelhead, and/or eulachon to suspended sediment from this project will be for minutes rather than hours and is extremely unlikely to approach the suspended sediment concentrations associated with adverse effects.

However, young of the year LCR Chinook salmon would be exposed to suspended sediment as well, causing lethal and sub-lethal adverse effects to an unknown number of fish. Because the project will adhere to work windows, we do not expect juvenile chum salmon will be present during dredging and dredge disposal.

Suspended sediment will also result from OGV traffic propeller movement, and wake erosion that results in continuous low-level sediment inputs with episodic large inputs from bank failure (Mueller 1980, Hilton and Phillips 1982, Warrington 1999, Kahler et al. 2000, McConchie and Tolman 2003, and Graham and Cooke 2008). Pile installation will also increase suspended sediment levels through the resuspension of sediment during construction.

The project-related suspended sediment increases will be localized and occur in a small portion of the lateral extent of the Columbia River; however, rearing and foraging behavior of juvenile salmonids, eulachon, and subadult green sturgeon will be altered during times of increased turbidity plumes for a duration of three months during dredging, pile installation, and intermittently throughout the year during OGV moorage. Although turbidity created by pile driving and OGV moorage will cause interruption of essential behaviors, it will not reach levels sufficient to kill or permanently injure juvenile or adult salmonids; juvenile or adult eulachon; or sub-adult green sturgeon. Additionally, the total area affected by increased turbidity is relatively small when compared to the total size of the Columbia River in the project area. With the exception of LCR Chinook salmon, rearing juveniles and migrating adults can relocate to other nearby areas to escape the turbidity plumes.

Construction of the mitigation site will occur outside of the wetted perimeter of the Columbia River. Once the levee is breached between the mitigation site and the river, a small amount of suspended sediment is expected to enter the river. However, because inundation will occur following construction and the mitigation site will slowly as the river fills the site, suspended sediment within the mitigation area will occur but is not expected to be of intensity and duration that could cause significant effects to ESA species in the Columbia River. Further, breaching would occur when fish are least likely to be present in the nearshore,

Because of project timing and location, adult or subadult green sturgeon are unlikely to be present in the action area or in the vicinity to where suspended sediment is expected. However, to be conservative, we assume there is a possibility of adult or subadult green sturgeon encountering turbid conditions related to the project. Green sturgeon are typically found in turbid conditions and forage in the benthos by stirring up the sediment to access benthic prey such as burrowing shrimp and is thus relatively tolerant of higher suspended sediment concentrations. As such, in the unlikely event that individual green sturgeon encounter turbidity and elevated suspended sediments related the project, effects on green sturgeon are not expected to rise to the level of harm or harassment.

Temporary Loss of Forage. Dredging will temporarily remove benthic forage (invertebrates) in the 41.5-acre dredge area. Maintenance dredging will episodically repeat this effect in a reduced area compared to initial dredge. Reduction in benthic forage will have impacts on listed fish, including green sturgeon. Although the dredge area is not small, it represents a fraction of available forage in the Columbia River in that action area due to the large size of the river. As such, forage will continue to be available around the dredge prism, and will remain intact close to shore where the most vulnerable juveniles salmonids are most likely to be found. Nevertheless, removal of forage will cause listed fish to seek out other areas to forage, delaying migration time and slightly reducing survival of listed salmonids and green sturgeon.

Stormwater. As mentioned in Section 2.4.2 above, trace metals and PAHs from coal leachate can cause direct or indirect toxicological effects on fish and their prey. For the coal leachate analysis, NMFs reviewed analyses that focused on two primary sources of coal (Uinta Basin and Powder River Basin) that would be exported from the CET. The leachate study data was used to identify potential concentrations of priority metals (Table 13, below) that could leach from coal stockpiles.

Table 13. Maximum Estimated Concentrations of Trace Metals in Untreated Coal Leachate Compared with State and Federal Chronic Water Quality Criteria for the Protection of Aquatic Life.

Dissolve d Metals	Maximum Concentration (ug/L) at the Edge of the Chronic Mixing Zone	Washingto n State Chronic Water Quality (ug/L) Criteria	Oregon Water Quality Standard for Aquatic Life (ug/L)	USEPA Chronic Water Quality Criteria (ug/L)	Difference between CET concentration at the chronic mixing zone boundary and the most protective state or federal standard[2]
Aluminum	28.83	-	-	87[3]	3 times lower
Arsenic	0.13	1	150	150	1,155 times lower
Cadmium	0.0013	0.	.16	0.72	123 times lower
Copper[4]	0.04	-	3.84	-	96 times lower
Mangane	2.86	-	-	120[5]	42 times lower
Selenium	0.26	5	4.6	3.1	12 times lower
Silver	0.0039	-	0.1	-	821 times lower
Zinc[4]	2.21	-	72.8	120	54 times lower

Table Credit: INFORMATION REQUEST RESPONSE MEMORANDUM, Grette Associates, December 17, 2018

Shaded cells represent the most protective chronic water quality criteria available.
[1] EPA criteria are for Region 10 waters (EPA 2018), unless otherwise noted.
[2] Compared to the most protective regulatory standard (shaded cells).
[3] The existing criteria for aluminum is 87 ug/L for pH ranging from 6.5 -9.0, across all hardness and dissolved organic carbon (DOC) ranges. In 2017, EPA proposed a revised chronic criterion for aluminum of 390 ug/L (normalized to pH = 7, hardness = 100 mg/L, DOC = 1 mg/L).
[4] Hardness dependent metals are all normalized to hardness 100 mg/L.
[5] USEPA Region 3 benchmark. No criteria established for manganese in Region 10.

As discussed in the stormwater subsection in Section 2.4.1, management at the project site is expected to prevent coal leachate from entering the river. Thus, we do not expect any fish exposures or response to this potential water quality impact. In the event that untreated coal leachate enters the river, increased levels of contaminants would be confined to a small dilution area and are unlikely to cause any effects on juvenile or adult fish using the area.

Coal Dust. Considering the low levels of contaminants and suspended sediment (as discussed in the effects on critical habitat subsection in Section 2.4.1 (page 66)) directly caused by coal dust, and because coal dust accumulation occurs over time, and the majority of coal dust entering the Columbia River would be transported downriver before settling out, it is unlikely that coal dust in the water column would have detrimental effects. Coal dust is expected to deposit in the mitigation area at very low rates (0.1 to 0.01 g/m/month). Tidal flushing would reduce residual coal dust such that it is unlikely any effects would occur related to contaminants in the mitigation area. The level of potential exposure of any listed fishes is very low.

Coal Spill. As discussed in Section 2.4.1, the chance of a coal spill occurring in the Columbia River or a tributary is extremely low. A spill could occur from a train derailment, from an OGV accident, or during loading and unloading at the CET. If a spill were to occur during spring when juvenile salmon or eulachon could be in the nearshore, effects could occur that range from avoidance response to death. It is impossible to predict the number of fish that could be killed or injured in such an event. Regardless, given the discrete, rare, and isolated nature of this type of event, the overall risk to individual salmon or eulachon would be extremely low. Because green sturgeon use deeper water away from the shoreline, they would not be expected to be injured or killed as a result of a coal spill.

OGV. Discharges of pollutants from emissions and exhaust are expected to occur in close proximity to the terminal around OGVs. Contaminant levels would likely increase in the water column during OGV moorage and may persist in sediments for longer periods of time. Increased contaminant levels will be localized and occur in a small portion of the lateral extent of the Columbia River. Further, dilution and river flow the river will preclude contaminants related to OGVs from reaching levels that would be expected to cause injury or cause significant change in behavior of larval eulachon, juvenile or adult fish in the action area.

Ballast Water. New ballast water discharges will occur once OGVs begin using the CET. As discussed earlier in this document, OGVs are required to conservation measures describe in the USCG's 2012 Biological Opinion. NMFS found that the discharge of ballast water using the initial numerical standard is unlikely to affect individual salmon, eulachon or green sturgeon in the Columbia River (and elsewhere)(NMFS 2012).

Heavy Equipment Operation. The use of heavy equipment during the proposed construction activities creates the opportunity for accidental spills of fuel, lubricants, hydraulic fluid, and other petroleum products, which, if spilled in the vicinity of the action area, could injure or kill aquatic organisms (Asplund 2000), as described above. The proposed conservation measures, such as implementing a spill containment plan, will minimize the risk of significant contaminant releases during in-water work. Based on the conservation measures, it is highly unlikely that a spill oil occur during the in-water work construction, therefore the risk to ESA-species is low.

Entrainment during Dredging

The probability of fish entrainment is largely dependent upon the likelihood of fish occurring within the dredge prism, dredge depth, fish densities, the entrainment zone (surface area of the clamshell impact plus the zone of induction for hydraulic dredges), location of dredging within the river, equipment operations, time of year, and species life stage. Demersal fish, such as green sturgeon, sand lance, sculpins, and sticklebacks are most likely to have the highest rates of entrainment as they reside on or in the bottom substrates with life-history strategies of burrowing or hiding in the bottom substrate (Nightingale and Simenstad 2001). Larson and Moehl (1990) concluded that it is unlikely that anadromous fishes are entrained in significant numbers by dredges, at least outside of constricted river areas.

Due to equipment characteristics, it is generally accepted that clamshell buckets do not entrain fish in the water column. Specifically, the clamshell bucket descends to the substrate in an open position. The force generated by the descent drives the jaws of the bucket into the substrate, "biting" the sediment upon retrieval. During the descent, the bucket does not trap or contain a mobile organism, because it is completely open. Due to the understanding of the operation of the clamshell, no specific studies of entrainment of salmonids or other fish have been conducted on this type of equipment. Based on the operation of the clamshell dredge bucket, it is concluded that no entrainment of fish or other mobile organisms in the water column would occur during mechanical dredging with a clamshell bucket.

Juvenile salmonids prefer the shallow, nearshore depths rather than the deeper areas where dredging would occur. Adult and larger juvenile salmonids that could occupy the dredge area would be of sufficient size and would have the swimming speed to avoid potential entrainment. Consequently, the risk of entrainment of adult or juvenile salmon or steelhead by the dredge is extremely low.

Like salmon, adult eulachon would avoid dredge operations. In the Columbia River system Eulachon spawn primarily from February through March. Larval Eulachon drift downstream and are typically out of the Columbia River by July (PSMFC, 1996). Because dredging will occur during the in-water work window of September through December, we do not expect eulachon eggs or larvae to be present during dredge operations.

Few, if any, green sturgeon are likely to be present within the action area during the period in which the action is proposed because they are not known to use LCR estuary habitat for rearing except during the late spring through summer months. Also, in the event that green sturgeon that may be present, they are likely to be larger subadults fully able to avoid the dredge head without adverse effects.

Ship Wake Stranding. Ship wakes from OGV traffic transiting on the Columbia River to and from the CET are likely to cause indirect effects on listed species. Such wakes can erode shoreline habitats and strand juvenile fish, primarily early stage, juvenile salmonids. Four studies (Bauersfeld 1977, Hinton and Emmett 1994, Ackerman 2002, Pearson *et al.*, 2006) have indicated that under certain conditions, deep draft vessels can produce wakes that strand juvenile salmon in the Columbia River. In 1975, it was estimated that 14,500 juvenile Chinook, 1,359 juvenile coho, and 4,771 juvenile chum salmon were stranded because of ship wakes from 180 deep draft vessels (Bauersfeld 1977). None of these studies observed green sturgeon or eulachon stranding from ship wakes.

Pearson et al. (2006) examined fish wake stranding at three 'sentinel' beaches in the Lower Columbia River recovery domain in the summer of 2004 and spring and winter and spring of 2005. In that study, 126 deep-draft vessel transits were monitored and stranding occurred at all three sites over all three seasons, ranging from a low of 15 percent at Sauvie Island to a high of 53 percent at Barlow Point (i.e., 53 percent of vessel transits at Barlow Point caused stranding). In exploring this issue, the authors found that multiple factors were involved in the probability that a stranding event might occur. These included: proximity to shipping lane, tidal stage, tidal height, flow, current velocity, vessel type, vessel direction, load of the vessel (i.e., loaded/unloaded), vessel speed and size (length, beam, draft, fish availability, beach characteristics (e.g., slope, shielding factors), and total wave excursion. In this study location, a proxy for ship kinetic energy (accounting for ship size and speed), and fish availability were found to have the greatest association with stranding occurrences, but the authors noted expressly that no single factor could be construed to govern the likelihood of stranding.

Considering these results, obtained from only three beaches along the Lower Columbia River, Pearson et al. (2008) conducted a subsequent spatial analysis at the desk-top level with GIS in attempt to characterize other beaches that might be susceptible to stranding, based on the confinement of the channel, beach distance from the navigation channel, beach shielding features, beach slope, submerged berms in the navigational channel, and fine scale beach features. Using data from the Lower Columbia River Estuary Partnership for fine scale features, NOAA and Corps data on bathymetry, and aerial photography from the US Department of Agriculture, they determined that physically-based susceptibility to stranding of juvenile salmonids by ship wakes is likely limited to approximately 16 percent of the lower river (about 33 miles) mostly upstream of the CET facility where the shorelines is close to the channel, not shielded from wave action, and the beach slopes is less than 10 percent. Applying these parameters, which have yet to be field-verified, the authors concluded that the highest susceptibility of stranding occurs on about 8 miles of shoreline in the LCR recovery domain, upstream of the lowest 25 miles of the river.

Additional wake stranding data has been collected for nearly two years continuously (2-10 surveys a week) along the Columbia River shoreline (approximately RM 87) at the mouth of the Lewis River by Plas Newydd LLC (sponsors of the Wapato Valley Mitigation and Conservation Bank), upstream of the CET. The Plas Newydd monitoring and data collection indicates a pattern of stranding events during lower water surface elevations in the Columbia River starting in early January through early April coinciding with juvenile fish presence (specifically 30 – 50 mm fall Chinook salmon fry), and OGVs on their way to upstream ports or on their way down the Columbia River. This effort indicates that on average 27.3 % of OGVs resulted in stranded salmonids and 37.8 % of OGVs stranded fish of any species. Of those OGVs that stranded salmonids, salmonids were stranded at an average rate of just over 10 fish/vessel survey, ranging from a low of 2 fish stranded to a high of 300 fish (on one occasion) stranded per OGV passage at this location (K. Jorgensen pers. comm, Plas Newydd LLC unpublished data 2020).

Pearson et al., (2006) concluded that fish stranding occurred with larger vessels (bulk carriers, container ships, oil tankers, and car carriers) but was not observed with tug boats or smaller vessels transiting the shipping lanes. Smaller recreational boats also have been observed by other NMFS personnel (D. Bambrick, personal communication, 6-7-2017) to cause strandings in other river systems when operating at fast speeds closer to shore. Different types of vessels, depending on size and bow configuration, produced different patterns of wave draw-down and surge. From modeling different variables, ship speed was estimated to have the greatest effect on wave generation. For example, decreasing a ship’s speed with a 16 meter beam from 14 knots to 12 knots was predicted to have a 63 percent decrease in wake height (Pearson et al., 2006).

The Columbia River Estuary ESA Recovery Plan Module (NMFS 2011d) states that options for reducing the effects of vessel wake stranding are limited, primarily because of the lost revenues that would result from potential slower ship travel. Ship traffic through the estuary will continue, and the speed of ships traveling through the estuary may be difficult to alter because of safety concerns. The U.S. Coast guard regulates traffic and speed within the LCR navigation channel.

Modification of some habitats may be necessary to reduce this threat. Ship wake stranding is considered a primary contributor to a low-priority limiting factor for the Columbia River (NMFS 2011d).

The increase in OGVs resulting from the proposed action will likely increase the incidence of stranding and death of individuals of all populations of juvenile salmonids and to a lesser extent, eulachon. While individual eulachon have been observed in wake stranding events, their occurrence in these events is considered rare and only a few eulachon have been observed stranded at any one time.

Ship wake stranding is identified as a limiting factor for LCR Chinook salmon, Columbia River chum, LCR coho salmon, and LCR steelhead. Wake stranding is more severe for smaller individuals, and as such, ocean–type Chinook originating from LCR tributaries and CR chum are particularly vulnerable: larger, hatchery-reared components of the up-river ESUs appear less susceptible as they tend to outmigrate in deeper waters associated with the thalweg. Ocean going vessel speeds generally range from 9 to 15 knots in the Lower Columbia River, with the slower speeds in that range occurring while passing port areas; still slower speeds of between 6 and 9 knots occur while passing through anchorages (ICF et al, 2016). Ocean going vessels resulting from the proposed action will pass County Line Park at 9-15 knots. However, OGVs must reduce speed when approaching moorage or anchorage areas. Because Barlow Point is adjacent to the proposed CET, OGVs will be slowing to 6 to 9 knots while passing Barlow Point. Pearson (2006) indicated that ships moving below at 8 or lower knots were not observed to cause wake stranding. As such, we expect lower number of fish to be stranded at Barlow Point compared to pre-project conditions. However, following completion of the CET, we expect stranding at County Line Park and other unknown downstream sites that have physical criteria for stranding to increase a consequence of the CET project.

The proposed action will result in up to 840 additional OGV round trips per year for the design life of the project, 25-50 years. Even though we know some fish will be stranded, the uncertainty about the frequency of stranding events and the number of fish stranded in each event, makes it difficult to accurately determine the number of fish that would be killed each year. Nevertheless, we use the best scientific and commercial data available to analyze the effects of the proposed action, including wake stranding.

We examined two potential approaches to estimate the impact of listed fish being killed by wake stranding. The first is a qualitative method in which we examine the data on previous events and estimate if the number of fish killed by wake stranding would be substantial enough to have a significant impact on population abundance or productivity of any of the affected species. This approach may be appropriate for proposed actions that result in a small number of additional OGV trips and a low overall frequency of wake stranding. However, for an action that adds roughly four additional OGV trips per day (2 ships), a strictly qualitative approach would not be very informative.

The second approach would be to use the available information from previous studies to develop a quantitative approach to estimate the number of fish that are likely to be killed by wake stranding. We acknowledge there are potential problems with this approach. There is considerable uncertainty about the frequency, location, and severity of stranding events. Therefore, any quantitative estimate of wake stranding is likely to be associated with large confidence intervals, and is as likely to overestimate stranding as it is likely to underestimate stranding. We are also aware that the authors of some of the studies we considered warned against projecting their results to other sites or other circumstances. However, given the lack of a better alternative, we think a quantitative approach based on the results of previous studies is the best method to estimate the impact of wake stranding.

The proposed action will result in up to 840 new round trips (1,680 total trips up or down the river) of OGVs longer than 600 feet each year. These ships will travel past beaches during tides and river discharges produce stranding wake waves during times of the year when young-of-the-year LCR Chinook salmon, CR chum salmon, and LCR coho salmon are migrating or rearing in shallow water along the margins of the Columbia River. To estimate a total number of adult equivalents that could be stranded for each individual ESU or DPS, we scaled Pearson and Skalski (2011) stranding data to oil tanker trips from the CET using the Pearson et al. (2008) estimate of the length of beaches between CET and the ocean that could have a high risk of stranding. Ocean going vessels from the CET will pass two known stranding sites observed by Pearson and others. These sites are County Line Park and Barlow Point. Barlow Point is less than a mile downstream from the CET site. Once the CET is constructed and in use, OGVs will be required to slow to 8-9 knots in order to prevent damage-causing wakes at moored areas (CET). This speed is below where significant wake stranding would be expected to occur (Pearson, 2006). Therefore, we assert that OGVs from the CET and elsewhere may cause significantly less stranding at Barlow Point then existing data suggest. Wake stranding likely occurs at other beaches downstream of the CET that we do not have enough information to analyze, as discussed below.

The fraction of winter, spring and summer ship passings that stranded fish and the average number of fish stranded per passing was 15 percent and 7.3 fish at County Line Park. An average of 36 percent of ship passings stranded an average of 9.3 fish at all three beaches combined. Pearson et al. (2008) tested 208 river miles (104 miles on each side) of the LCR shoreline below Vancouver, Washington for beach slope, distance from the shipping channel, shielding by berms and other factors that cause stranding. Using remote GIS analysis, they found 33 miles of shoreline that has a moderate or high physically-based susceptibility to wake wave stranding and 8 miles that have a high susceptibility to wake stranding. However, this study included about 34 miles of shoreline upstream that will not be impacted by OGV's from the CET. Further, shorelines downstream between RM 0 and 22 are not susceptible to stranding (due to width of river and location of shipping channel) and the potential for wake stranding occurs on a small subset of the shoreline beaches between RM 25 and the project site at RM 63 (Pearson et al, 2008). As such, estimated stranding locations that would be affected by OGV's from the CET would be significantly less than the estimated 8 and 33 miles of estimated susceptible shorelines found in Pearson et al. 2008. However, we do not have precise location data to make a quantitative estimate in wake stranding sites that have not been studied. As such, we likely over-estimate stranding resultant from increase OGV traffic from the CET.

The CET will load up to 840 OGV per year that will travel up and down the Columbia River with a 41 foot draft, for a total of 1,680 trips. Of these passages, 1,260 will be during the winter, spring and summer months identified by Pearson and Skalski (2011) where 36 percent of passages are estimated to strand fish. As such, we an estimate a total of 2,598 stranded fish per year. Approximately eighty-five percent of these fish (2208) will be Fall Chinook, around 2 percent (52) will be coho, and 2 percent (52) will be chum salmon. The other 11 percent of stranded fish would be small numbers of salmon and steelhead that originate from upstream, or would be other species such as eulachon, trout, shad, and stickleback. With an average emergence to adult return (SAR) rate of 0.02, (Jeromy Jording pers. comm. to Scott Anderson) this is equal to the loss of a few adult Fall Chinook, and less than one chum and coho salmon per year. Green sturgeon have not been observed in stranding events and are not expected to be stranded as a result of the CET project.

Harassment from Increased OGV Traffic. The proposed CET will increase the amount of OGV traffic in the Lower Columbia River by 59 percent. Boating activity affects ESA-listed fish in a number of ways. The physical presence of boat hulls may disturb or displace nearby fishes (Mueller 1980). Graham and Cooke (2008) studied the effects of three boat noise disturbances (canoe paddling, trolling motor, and combustion engine (9.9 hp)) on the cardiac physiology of largemouth bass (*Micropterus salmoides*). They found that exposure to each of the treatments resulted in an increase in cardiac output in all fish, associated with a dramatic increase in heart rate and a slight decrease in stroke volume, with the most extreme response being to that of the combustion engine treatment. Recovery times were the least with canoe paddling (15 minutes) and the longest with the power engine (40 minutes). They postulate that this demonstrates that fish experienced sublethal physiological disturbances in response to the noise propagated from recreational boating activities. Directly, engine noise, prop movement, and the physical presence of a boat hull will likely disrupt or displace nearby fishes (Mueller 1980).

Only a portion of the Columbia River will be affected by increased ship traffic, particularly in close proximity to the dock where OGVs will moor. The fish present are likely to suffer some of the adverse effects described above, but no fish are expected to be injured or die as a result of this exposure.

Summary of Effects on Salmonids, Eulachon, and Green Sturgeon. The in-water work required for the proposed action is scheduled to occur during days of the year when all species of juvenile salmonids are present for either rearing or migration; however, it will not occur during peak abundance. Adults of the following species will also be present in the action area during the in-water work: CR chum salmon-peak occurrence; LCR coho salmon-peak occurrence; UWR steelhead-relatively abundant; and eulachon-peak occurrence. All ESA-listed fish species will be present in the action area at some point during year-round operation of the dock, including the increased OGV traffic.

Migration habitat for juvenile and adult salmonids and eulachon is present in the action area. Rearing habitat for juvenile salmonids, green sturgeon, and eulachon is present in the action area.

Most of the fish present will incur short-term stress due to loud sounds, reduced water quality during dredging and general disturbance from construction. Salmonids would also be injured or killed from increased predation, pile driving, suspended sediments, and wake stranding. Larval Eulachon would be injured or killed from increased predation, a small number of adult Eulachon would be injured or killed from wake stranding. Green sturgeon and salmonids are also expected to be harmed from temporary loss of forage resultant from dredge operations.

Marine Mammals and Leatherback Sea Turtles

Six species of ESA-listed marine mammals (sei whales, blue whales, fin whales, humpback whales and sperm whales) and leatherback sea turtles occur in the Pacific Ocean portion of the action area and are likely to be affected by the proposed action.

Increased Risk of Ship Strikes on Marine Mammals and Sea Turtles. As discussed in the Environmental Baseline section, collision with vessels remains a source of anthropogenic mortality or serious injury for both sea turtles and whales.

The effects of a ship strike will impact all ESA-listed marine mammals considered in this opinion in a similar nature (i.e., it will injure or kill them). Although the occurrence is variable for different species in the action area, the effects will occur year-round and will have an equal chance of affecting individuals of different species. Therefore, we are not conducting an analysis of ship strike effects on each individual species of marine mammal.

The proposed project will lead to increased OGV traffic that would not exist but for the proposed action. We assume that the risk of an OGV collision is proportional to the number of whales/turtles and OGVs in an area; however, defining the proportionality requires more information than is currently available at this scale. The increase in marine OGV traffic (840 ships/1680 trips per year) from the proposed action will result in some increased risk of a ship strike with fin whales, humpback whales, blue whales, sei whales, sperm whales and leatherback sea turtles because of the overlap between OGVs and these whales and leatherbacks. However, due to the limited information available regarding the incidence of ship strike and the factors contributing to a ship strike event, it is impossible to determine whether a particular number of OGV transits or a percentage increase in vessel traffic will translate into a number of collisions or percent increase in collision risk. For example, we cannot determine based on the available information, the exact destination or travel corridors for the associated ships exiting the Columbia River. The destination of ships leaving the proposed facility is also likely to change over time based on many factors including market demand. It is therefore impossible to compare the precise overlap in shipping and whale density to estimate the increased risk of a collision. In spite of being one of the primary known sources of direct anthropogenic mortality to whales, and to a lesser degree, sea turtles, ship strikes remain relatively rare, stochastic events. In the context of all of the shipping traffic in the range of the whales and leatherbacks in the action area, the increase in total ship traffic in the action area where turtles and whales could be struck, is small. Nonetheless, the risk of a collision between a vessel and a whale or leatherback sea turtle will increase due to new traffic in the future.

Effects of Ship Strikes on Marine Mammals and Leatherback Turtles. Large whales are vulnerable to injury and mortality from ship strikes (Vanderlaan and Taggart 2007). Due to the overlap of heavy shipping traffic and high whale density, Oregon and Washington waters are a high risk area for ship strike events, particularly in the continental shelf and shelf slope (Laist et al. 2001).

In U.S. waters, ship strikes account for tens of large whale deaths per year (Con and Sibler 2013, Henry et al. 2012, Van der Hoop et al. 2012), and in the hundreds of deaths each year globally (Con and Sibler 2013, Laist et al. 2001, Jensen and Sibler 2003, Van Waerebeek et al. 2007). The documented number of ship strikes is an underestimate of the actual number of collisions because ship strikes have a low probability of detection (Laist et al. 2001, Con and Sibler 2013).

Ship strike injuries to whales include propeller wounds characterized by external gashes or severed tail stocks, blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae (Laist et al 2001), and hemorrhaging that sometimes lacks external expression (Con and Sibler 2013). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. A majority of whale ship strikes seem to occur over or near the continental shelf, probably reflecting the concentration of vessel traffic and whales in these areas (Laist et al. 2001). As discussed in the Status of the Species section, all whales are potentially vulnerable to collisions with ships in areas where there is overlap.

Limited data are available on whale behavior in the vicinity of an approaching vessel and the hydrodynamics of whale/vessel interactions. The conservation measures outlined in the NOAA Fisheries West Coast Region Recommendations to Avoid Collisions are the best available means of reducing ship strikes of whales: (1) Consult the Local Notice to Mariners in your area or Coast Pilot for more information; (2) Keep a sharp look-out for whales, including posting extra crew on the bow to watch, if possible; (3) Reduce speeds while in the advisory zones, or in areas of high seasonal or local whale abundance; and (4) If practicable, re-route vessel to avoid areas of high whale abundance (available at: http://www.westcoast.fisheries.noaa.gov/protected_species/marine_mammals/ship_strikes_recommendations.html).

Vessel size and speed are associated with the number and severity of ship strikes with whales. Of collisions that killed whales, at least 87 percent involved ships more than 80 m long (Laist *et al*. 2001). There is a significant positive relationship between ship speed and the probability of a lethal injury (Conn and Sibler 2013). Most fatal injuries to large cetaceans are caused by large motorized vessels at speeds of 14 knots or faster (Laist et al. 2001). The probability for a strike to be fatal increases from 21% to 79% as speed increases from 8.6 to 15 knots, respectively (Vanderlaan & Taggart 2007). The OGVs that will be used for the proposed CET project will be 600-900 ft long and will travel at an average speed of 12-13 knots, with top speed of 15 knots when in the Pacific Ocean. Given the length and the speeds at which the OGVs are likely to travel, they pose some risk of collision between these OGVs and marine mammals. In addition, the OGVs proposed for the CET project may not use NOAA Fisheries West Coast Region Recommendations to Avoid Collisions, and there are no regulations currently in place to restrict vessel activity in the vicinity of whales in the action area. As such, there is a likelihood that the whales may not be able to avoid approaching OGVs, particularly when traveling at higher speeds. Based on the above, NMFS assumes that any whales or leatherback turtles struck by OGVs will likely die as a result of OGV collision.

Sea turtles, including leatherbacks, must surface to breathe and several species are known to bask at the surface for long periods making them more susceptible to ship strikes. Ship strikes have been identified as one of the important mortality factors in several nearshore turtle habitats worldwide (Denkinger et al. 2013). However, available information is sparse regarding the overall magnitude of this threat or the impact on sea turtle populations globally. Although Leatherback turtles can move somewhat rapidly, they apparently are not adept at avoiding ships that are moving at more than 4 km per hour; most ships move far faster than this in open water (Hazel and Gyuris 2006; Hazel et al. 2007; Work et al. 2010). Hazel et al. (2007) suggests that green turtles (and presumably leatherback turtles) may use auditory cues to react to approaching ships rather than visual cues, making them more susceptible to strike as ship speed increases. Since turtles that were previously killed or injured as a result of some other stressor (e.g., fishing net entanglement or disease) may be more susceptible to a ship strike, it is not always known what proportion of ship wounds were sustained ante-mortem versus post mortem (or post injury).

In spite of being one of the primary known sources of direct anthropogenic mortality to whales and leatherback turtles, ship strikes remain relatively rare, stochastic events. The proposed project will lead to increased long-term operation that will increase the amount of vessel traffic, and will result in some increased risk of ship strike, and a high likelihood of death, if struck, of listed species. For fin whale, humpback whale, and leatherback turtle, we have sufficient information to conduct a quantitative analysis linking the increased OGV traffic associated with the project to a potential number of ship strikes or mortalities in the action area. Due to the limited information available regarding the incidence of ship strikes and the factors contributing to ship strike events, it is difficult to determine how a particular number of vessel transits or a percentage increase in OGV traffic will translate into a number of likely ship strike events for blue, sei, and sperm whales. We can instead qualitatively assess their relative risk from the project in the context of existing information on population size and other spatial information, below.

Likelihood of OGV Collisions

Humpback whale

Likelihood of Humpback whale exposure

The likelihood that humpback whales will be exposed to collisions with CET OGVs is high. CET OGVs will make 420 round trips per year during the warm six months of the year when there is an average humpback whale density of 0.0046 humpback whales per square mile (Becker et al., 2016) in the action area. It is extremely unlikely that exposure to OGVs would occur during the other six months of the year when Humpback Whales are not expected in the action area. The 420 CET OGVs could encounter 6.5 humpback whales per year, although a fraction of these are expected to be killed or injured.

Magnitude of humpback response

The magnitude of response of humpback whale exposure to CET OGV collisions is high. Whales may be swimming at a depth below the bottom of the OGV or may take action to avoid colliding with the OGVs but at 13 nautical miles per hour, there is a 70 percent probability that a whale will be killed by a collision with an OGV.

Consequence of exposure and response to individual fitness of humpback whales

The consequence of exposure and response to a collision between a CET OGV and a humpback whale to individual fitness is high because the likelihood of exposure is high and the magnitude of response is high. Using coefficients from Rockwood, 2016, CET OGVs could kill 1.4 humpback whales per year.

Fin Whale

Likelihood of Fin whale exposure

The likelihood that fin whales will be exposed to collisions with CET OGVs is high. Fin whales feed farther offshore than humpback whales. CET OGVs will make 420 (out of 840) round trips during six months when an average of 0.0045 fin whales per square nautical mile (Becker et al., 2016) are feeding off the coast of Washington and Oregon. It is extremely unlikely that exposure to OGVs would occur during the other six months of the year when Fin Whales are not expected in the action area. The 420 CET OGVs could encounter 8 fin whales per year.

Magnitude of fin whale response

The magnitude of response of fin whale exposure to CET OGV collisions is high. Whales may be swimming at a depth below the bottom of the OGV or may take action to avoid colliding with the OGVs but at 13 nautical miles per hour, there is a 70 percent probability that a fin whale will be killed by a collision with an OGV.

Consequence of exposure and response on Fin whale fitness

The consequence of exposure and response to a collision between a CET OGV and a fin whale to individual fitness is high because the likelihood of exposure is high and the magnitude of response is likely mortality. Using coefficients from Rockwood, 2016, CET OGVs could kill 1.5 Fin whales per year.

Blue whale, sei whale, or sperm whale

Likelihood of blue whale, sei whale, or sperm whale exposure

The likelihood that blue whales, sei whales, or sperm whales will be exposed to CET OGV strikes is low. As described in the Status of the Species section of this Opinion, these whale stocks/populations do not migrate to the action area each year to feed, although individuals from these species are detected in the action area. Because spatial and temporal density is so low, it is logical that the encounter rate between CET OGVs and these whale species would be orders of magnitude lower than the encounter rate estimated for humpback whales and fin whales.

Magnitude of blue whale, sei whale, or sperm whale response

The magnitude of response of, blue whale, sei whale, or sperm whale response to a CET OGV encounter is high. Whales may be swimming at a depth below the bottom of the OGV or may take action to avoid colliding with the OGVs but at 13 nautical miles per hour, there is an 70 percent probability that a fin whale will be killed by a collision with an OGV.

Consequence of exposure and response on blue whale, sei whale, or sperm whale individual fitness.

The consequence of exposure and response to a collision between a CET OGV and a blue whale, sei whale, or sperm whale to individual fitness is low because the likelihood of exposure is low.

Leatherback Turtle

Likelihood of leatherback sea turtle exposure

The likelihood that leatherback sea turtles will be exposed to collisions with CET OGVs is high. CET OGVs will make 230 round trips during the warm 100 days of the year when up to 0.028 leatherback sea turtles per square nautical mile are feeding inside the 200 foot isobaths along the Washington and Oregon EEZ. Based on the solution described in Koopman (1956) (Appendix 2) each CET OGV would likely come within the critical encounter distance of approximately 1.5 leatherback sea turtles per year, with a mortality probability of 0.25, resulting in less than one leatherback being struck and killed each year. During the cooler 265 days of the year, leatherback turtles are not expected to be present in the action area in enough numbers to result in ship strikes.

Magnitude of leatherback sea turtle response

The magnitude of response of leatherback sea turtles to exposure to CET OGV collisions is high. Approximately 1.5 leatherback sea turtles per year may come within the critical encounter distance of a CET OGV. Turtles may be swimming at a depth below the bottom of the OGV or may take action to avoid colliding with the OGV but it is likely that a fraction of these encountered turtles will be struck by a CET OGV.

Consequence to individual fitness of leatherback sea turtles

The consequence of a collision between a CET OGV and a leatherback sea turtle depends on the speed of the OGV. We could find no studies on the relationship between OGV speed and leatherback sea turtle collision survival. It is likely that a fraction of the turtles struck by the OGV will be injured or killed.

Effects of Acoustic and Physical Disturbance on Marine Mammals. When anthropogenic disturbances elicit responses from marine mammals, it is not always clear whether they are responding to visual stimuli, the physical presence of humans or manmade structures, or acoustic stimuli. Because sound travels well underwater, it is reasonable to assume that, in many conditions, marine organisms would be able to detect sounds from anthropogenic activities before receiving visual stimuli. As such, exploring the specific effects of sound on marine mammal and sea turtle behavior provides a reasonable and conservative estimate of the magnitude of disturbance caused by OGV traffic.

Marine organisms rely on sound to communicate with conspecifics and derive information about their environment. There is growing concern about the effect of increasing ocean noise levels due to anthropogenic sources on marine organisms, particularly marine mammals. Effects of noise exposure on marine organisms can be characterized by the following range of physical and behavioral responses (Richardson *et al*. 1995):

1. Behavioral reactions – Range from brief startle responses, to changes or interruptions in feeding, diving, or respiratory patterns, to cessation of vocalizations, to temporary or permanent displacement from habitat.
2. Masking – Reduction in ability to detect communication or other relevant sound signals due to elevated levels of background noise.
3. Temporary threshold shift – Temporary, fully recoverable reduction in hearing sensitivity caused by exposure to sound.
4. Permanent threshold shift – Permanent, irreversible reduction in hearing sensitivity due to damage or injury to ear structures caused by prolonged exposure to sound or temporary exposure to very intense sound.
5. Non-auditory physiological effects – Effects of sound exposure on tissues in non-auditory systems either through direct exposure or as a consequence of changes in behavior, (*e.g.*, resonance of respiratory cavities or growth of gas bubbles in body fluids).

Source level data specific to the OGVs proposed to be used for this project are not available; however, data exist for other tankers of similar size and power. Large commercial vessels and supertankers have powerful engines and large, slow-turning propellers. These vessels produce high sound levels, mainly at low frequencies. At these frequencies the noise is dominated by propeller cavitation noise combined with dominant tones arising from the propeller blade rate (Neptune 2005). A large bulk cargo ship called the Overseas Harriette has been used previously as a model for an LNG carrier in transit and transmitted a dominant frequency of 50 Hz (Neptune 2005).

Blue, humpback, and fin whales are all known to be sensitive to sounds within the frequency ranges of OGV noise. Blue whales vocalize at frequencies between 12.5-200 Hz (Au et al. 2000). Sperm whales are odontoCETes, and are considered mid-frequency specialists rather than low frequency specialists, although sperm whales are also known to produce loud broad-band clicks from about 100 Hz to 20 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz. Vessel noise will not likely be within the most sensitive hearing frequency of sperm whales.

None of the noise associated with OGV activity is expected to reach levels that would potentially cause direct physical injury *(i.e.,* ear drum damage) to marine mammals. All OGV-related noise is continuous, and has the potential to result in some type of behavioral disturbance or harassment, including displacement, site abandonment (Gard 1974; Reeves 1977; Bryant et al.1984), and masking (Richardson et al. 1995). These disturbances could cause minor, short-term displacement and avoidance, alteration of diving or breathing patterns, and less responsiveness when feeding. Vessel noise can also cause acoustically induced stress (Miksis et al. 2001 in NRC 2003) which can cause changes in hear rate, blood pressure, and gastrointestinal activity. Stress can also involve activation of the pituitary-adrenal axis, which stimulates the release of more adrenal corticoid hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987, Rivest and Rivier 1995) and altered metabolism (Elasser et al. 2000), immune competence (Blecha 2000) and behavior.

The evidence presented above indicates that animals do respond and modify behavioral patterns in the presence of noise, although adequate data do not exist yet to quantitatively assess or predict the significance of minor alterations in behavior and shifts in energy budgets or accumulation of stress responses to the health and viability of marine mammal populations.

OGVs will produce sound frequencies in the hearing range of blue, fin, and humpback whales; however, the sound pressures levels will be transient and will attenuate to background ambient sound levels a short distance from the OGV. Individuals may react to noise generated, or the presence of, OGVs by changing the direction of their movements, or increasing their swimming speed. Although these reactions could increase an individuals' energy budget, the effects are likely to be temporary.

Effects of Acoustic and Physical Disturbance on Leatherback Sea Turtles. As noted previously in relation to anthropogenic noise, sea turtles are thought to be far less sensitive to sound than marine mammals. Leatherback sea turtles may be exposed to potentially disturbing levels of sound during OGV transit. Temporary, short-term behavioral effects, such as decreased ability to monitor its acoustic environment, cause habituation, or sensitization (decreases or increases in behavioral response) (Dow *et al.* 2012), during OGV transit are likely. However, a single individual's exposure to OGV noise is likely to be transient, as all of the turtles in the action area are migratory, and a single individual is not likely to be within the zone of impact year-round. We anticipate that the temporary behavioral changes and acoustically-induced stress from the moderate noise output associated with OGV transit are likely to adversely affect leatherback turtle individuals.

2.5 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. While relevant future climate-related environmental conditions in the action area are described in the Rangewide Status of the Species and Critical Habitat (Section 2.2), because we understand that the proposed action will have a design life of multiple decades (50 years or longer) we can project that the action area is likely, over that time, to experience climate effects such as warming water temperatures, greater variability in both drought and flood conditions, modified chemistry (salinity and acidity), and shifting food webs. Each of these effects is likely to diminish the value of ongoing fish habitat restoration activities in the Lower Columbia Region.

For this action, state or private activities in the vicinity of the project location are expected to cause cumulative effects in the action area. Additionally, future state and private activities in upstream areas are expected to cause habitat and water quality changes that are expressed as cumulative effects in the action area. Our analysis considers: (1) how future activities in the Columbia basin are likely to influence habitat conditions in the action area, and (2) cumulative effects caused by specific future activities in the vicinity of the project location.

Approximately 6 million people live in the Columbia River Basin, concentrated largely in urban parts of the lower Columbia River. We do not have information on expected growth in the Columbia River Basin. Therefore, we refer to population growth estimate for the State of Washington, which is 1.6 percent. Based on this estimate, we expect an additional 1.2 million people in the Columbia River Basin by 2029. Clark County is expected to grow from a 2020 population of approximately 472,500 to roughly 541,000 in 2040, though Cowlitz and Wahkiakum are expected to decline slightly in the same timeframe (OFM 2018). The past effect of that population is expressed as changes to physical habitat and loadings of pollutants contributed to the Columbia River. These changes were caused by residential, commercial, industrial, agricultural, and other land uses for economic development, and are described in the Environmental Baseline (Section 2.3). The collective effects of these activities tend to be expressed most strongly in lower river systems where the impacts of numerous upstream land management actions aggregate to influence natural habitat processes and water quality. We anticipate that these effects will continue in the future due to continued population growth.

Resource-based industries (e.g., agriculture, hydropower facilities, timber harvest, fishing, and metals and gravel mining) caused many long-lasting environmental changes that harmed ESA-listed species and their critical habitats, such as basin-wide loss or degradation of stream channel morphology, spawning substrates, instream roughness and cover, estuarine rearing habitats, wetlands, floodplains, riparian areas, water quality (e.g., temperature, sediment, dissolved oxygen, contaminants), fish passage, and habitat refugia. Those changes reduced the ability of populations of ESA-listed species to sustain themselves in the natural environment by altering or interfering with their behavior in ways that reduce their survival throughout their life cycle. The environmental changes also reduced the quality and function of critical habitat PBFs that are necessary for successful spawning, production of offspring, and migratory access necessary for adult fish to swim upstream to reach spawning areas and for juvenile fish to proceed downstream and reach the ocean. Without those features, the species cannot successfully spawn and produce offspring.

While widespread degradation of aquatic habitat associated with intense natural resource extraction is no longer common, ongoing and future land management actions are likely to continue to have a depressive effect on aquatic habitat quality in the Columbia River basin and within the action area. As a result, recovery of aquatic habitat is likely to be slow in most areas and cumulative effects from basin-wide activities are likely to have a slightly negative impact on population abundance trends and the quality of critical habitat PBFs.

Within the action area there are numerous over-water structures that will remain into the future. These include private and commercial marinas. In addition, large sections of the bankline on both sides of the LCR have been armored with rock riprap. These alterations have impacted biological and physical characteristics of the habitat, increased shading and increasing use by predatory fish and reducing natural cover that would provide refuge for listed fish. We expect the general habitat characteristics and quality in the action area to remain stable which will continue to have a negative impact on population abundance and productivity.

Thus, we assume that future private and public actions will continue within the action area. As the human population in the action area continues to grow, demand for agricultural, commercial, or residential development and supporting public infrastructure is also likely to grow. We believe the majority of environmental effects related to future growth will be linked to land clearing, associated land-use changes (i.e., from forest to lawn or pasture) and increased impervious surface and related subbasin changes that contribute contaminants to area waters. Land use changes and development of the built environment that are detrimental to salmonid and eulachon habitats are likely to continue under existing zoning. Though there are existing regulations that could decrease potential adverse effects on habitat function, as currently constructed and implemented, they still allow incremental degradation to occur. Over time, the incremental degradation, when added to the already degraded environmental baseline, can result in reduced habitat quality for at-risk salmon, steelhead, and eulachon.

In 2013, we adopted a recovery plan for LCR Chinook salmon, LCR coho salmon, CR chum salmon, and LCR steelhead developed by NMFS, Lower Columbia Fish Recovery Board (LCFRB), WDFW, and ODFW in collaboration with local citizens, tribes, technical experts and policy makers to protect and restore salmon and steelhead runs within the LCR. The LCFRB, WDFW and partners are conducting several on-going habitat restoration projects within sub-basins of and along the LCR that include, but are not limited to, riparian plantings, removal of fish passage barriers, culvert replacements, and placement of in-stream habitat structures. The recovery plan for eulachon is under development; however, on-going habitat restoration projects for salmonids are likely to be of benefit to eulachon as well.

NMFS also expects natural phenomena in the action area (e.g., ocean cycles, climate change) storms, natural mortality) will continue to influence ESA-listed fish. Climate change effects are likely to include reduced base flows, altered peak flows, and increased stream temperature. Other effects, such as increased vulnerability to catastrophic wildfires, may occur as climate change alters the ecology of forests.

The action area includes the OGV shipping traffic that overlaps with the continental shelf and slope, located up to 40 miles offshore of Oregon and Washington. Activities that may occur in these areas will likely consist of state government actions related to ocean use policy and management of public resources, such as fishing or energy development projects. Changes in ocean use policies as a result of government action are highly uncertain and may be subject to sudden changes as political and financial situations develop. Examples of actions that may occur include development of aquaculture projects; changes to state fisheries which may alter fishing patterns or influence the bycatch of ESA-listed marine mammals and sea turtles; installation of hydrokinetic projects near areas where marine mammals and sea turtles are known to migrate through or congregate; designation or modification of marine protected areas that include habitat or resources that are known to affect marine mammals and sea turtles; and coastal development which may alter patterns of shipping or boating traffic; however, none of these potential state, local, or private actions, can be anticipated with any reasonable certainty in the action area at this time. Even if some of the projects were developed with any certainty, the level of direct or indirect effects associated with most of these types of actions appear speculative at this point. Current and continuing non-federal actions that may occur in the action area and may be affecting ESA-listed marine mammals and sea turtles are addressed in the environmental baseline section.

When considered together, these cumulative effects are likely to have a small, adverse effect on salmon, steelhead, whales, turtles, green sturgeon, and eulachon population abundance and productivity. To the extent that non-federal recovery actions are implemented and on-going actions continued, adverse cumulative effects may be minimized, but will probably not be completely avoided. NMFS also expects natural phenomena in the action area (e.g., ocean cycles, climate change, storms, natural mortality) will continue to influence ESA-listed marine mammals and leatherback sea turtles. Climate change effects for salmonids and marine mammals are likely to include changes in food and habitat availability and survival. Changes specific to marine mammals would also include decreases in breeding and feeding locations, and decreased productivity. Climate change effects for leatherback sea turtles are likely to include decreased nesting success, and skewed sex ratios.

2.6 Integration and Synthesis

The Integration and Synthesis Section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we will add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency’s biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2).

2.6.1 Listed Fishes and their Critical Habitat

Salmon, Steelhead, Green Sturgeon, and Eulachon

Adult and juvenile salmon, steelhead, green sturgeon, and eulachon migrate through the action area. Many of the species also spend time rearing in the action area, and eulachon spawn in the action area. Therefore, individuals from all the populations of the species considered in this opinion are likely to be affected by the proposed action. Over the past several years, NMFS has engaged in various section 7 consultations on Federal projects impacting these populations and their habitats, and those impacts have been taken into account in this opinion.

The status of most of the fish species addressed by this consultation is “threatened.” Two fish species are listed as endangered: Upper Columbia River spring-run Chinook salmon, and Snake River sockeye. The status of the constituent populations of the various salmonid species ranges considerably from very high risk to moderate risk. Among all listed fish, the total abundance for these species is low relative to historical levels, and the historic range and is curtailed, or modified, and multiple factors, including systemic conditions throughout their habitat as a baseline matter, limit their productivity (constrain the carrying capacity in a manner that prevents increased abundance).

The environmental baseline is such that individual ESA-listed species in the action area are exposed to reduced water quality, lack of suitable riparian and aquatic habitat and restricted movement due to developed urban areas and land use practices. These stressors, as well as those from climate change, already exist and are considered together with any adverse effects produced by the proposed action. Major factors limiting recovery of the ESA-listed species considered in this opinion include degraded estuarine and nearshore habitat; degraded floodplain connectivity and function; channel structure and complexity; riparian areas and large wood recruitment; stream substrate, streamflow; fish passage; water quality; harvest and hatchery impacts; predation/competition; and disease. Modified channel habitat through repeated navigational and port area deepening has simplified the Columbia River habitat and removed extensive amounts of shallow water rearing habitat, limiting diversity.

When we consider the design-life of the project, which is reasonably expected to be 50 years of operation, we must also anticipate the future effects of climate change and other cumulative effects in the action area of non-Federal activities. Climate change over the next 50 years is likely to include greater variability in freshwater systems, as water volumes shift with changing weather patterns bring more frequent droughts and larger floods, and warmer water temperatures as river systems become more rain dominant than snow dominant. In the estuarine and ocean environment climate change is likely to also alter water temperatures, as well as change chemical characteristics such as decreased salinity and increased acidity.

Simultaneously, we can anticipate among the cumulative non-federal effects greater demands on freshwater water as human population growth increases consumption, and increasing water pollution in fresh and estuarine areas as urbanization increases and modifies the constituents of stormwater – for example, Clark County is expected to grow from a 2020 population of approximately 472,500 to roughly 541,000 in 2040, though Cowlitz and Wahkiakum are expected to decline slightly in the same timeframe (OFM 2018). As mentioned above in the cumulative effects section above, the non-federal cumulative effects anticipated over the 50 year life of the project are expected to be incrementally negative for habitat conditions, even when recovery actions are considered, based on the systemic character of degradation compared to the localized benefits of restoration.

To this context, we then add the anticipated direct and indirect effects of the project on species and habitat to determine the likely changes in abundance, productivity, spatial structure, or genetic diversity of the affected populations, and the implication for species viability.

Several species originate upriver of the Lower Columbia action area, and will pass through the action area as larger juveniles than those that originate in the Lower Columbia and its tributaries. Because these upriver fish have spent more time rearing than Lower Columbia origin fish, they would move through the action area as larger juveniles and would be able to use a greater variety of (deeper) habitats and would have the swimming ability to avoid most impacts. Nevertheless, these species would be affected by increased predation, suspended sediments, pile driving, reduced water quality, and wake stranding, albeit at smaller intensities than Lower Columbia-origin fish. The upriver species most vulnerable to predation is Snake River fall Chinook, based on their relatively small size when they are present in the action area. The upriver stocks include:

- Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon,
- Snake River (SR) sockeye salmon (*O. nerka*)
- Middle Columbia River steelhead, UCR steelhead, Snake River Basin (SRB) steelhead

The species that originate the Lower Columbia and its tributaries are discussed in more detail below. Of those species, the Columbia River chum and LCR fall Chinook salmon are the most vulnerable to predation, based on their relatively small size when they are present in the action area.

LCR Chinook salmon. Because LCR Chinook salmon rely on the action area for juvenile rearing to a greater extent than other ESU and DPSs discussed in this Opinion, they have the most co-occurrence with effects of the action. Impact pile driving will occur from September 1 through December 31.Dredging will occur from August 1 through December 31. Juvenile LCR Chinook salmon will be present at low numbers during the in-water work, and will be exposed to increased suspended sediment, increased contaminant levels, and hydroacoustic effects. Although the in-water work is likely to kill or injure fish in the area, this will not occur during peak occurrence (March through August 31) of LCR Chinook salmon. As such, only a small number of juveniles will be impacted by the in-water work during construction.

Following construction, all future cohorts of LCR Chinook salmon will be exposed to indirect lethal effects arising from the presence of the proposed action (predation) and the operation of the proposed action, including (wake stranding). These effects occur among juveniles, and most notably affects Fall Chinook, based on their relatively small size as they rear or migrate in the action area. Based on their natal streams, the following fall run populations most likely to experience the project effects of predation and ship wake stranding:

- Lower Cowlitz – a contributing population with baseline abundance of 500 and target abundance of 3000,
- Upper Cowlitz – a stabilizing population with zero baseline abundance and undetermined target abundance,
- Toutle – a primary population with baseline abundance of fewer than 50 fish, and a target abundance of 4000,
- Coweeman - a primary population with a baseline abundance of 100 fish and a target abundance of 900,
- Kalama – a contributing population with a baseline abundance of fewer than 50 fish and a target abundance of 500,
- Lewis – a primary population with a baseline abundance of fewer than 50 fish and a target abundance of 1500,
- Salmon Creek, - a stabilizing population with a baseline abundance of fewer than 50 fish and no target abundance,
- Washougal – a primary population with a baseline abundance of fewer than 50 fish and a target abundance of 1200,
- Upper Gorge – a contributing population with a baseline abundance of fewer than 50 fish and target abundance of 1200,
- Lower Gorge, a contributing population with a baseline abundance of fewer than 50 fish and target abundance of 1200,
- White Salmon, a contributing population with a baseline abundance of fewer than 50 fish and target abundance of 500,
- North Fork Lewis River late fall – a primary population with a baseline abundance of 7,300, which is also its target abundance.

The 12 populations exposed to the effects of this project when evaluated against the demographics of the ESU represent one third of the 32 total populations, over one half of the 20 fall populations of this ESU, just over one half of the 22 Washington populations of this ESU, and 92% of the Washington fall populations. Thus, irrespective of how the demographics are presented, the effects of the proposed action will expose a significant portion of the ESU every year for the life of the structure. The recovery plan notes that "[d]irect mortality from predation is a secondary limiting factor for all fall Chinook salmon populations. Anthropogenic changes to habitat structure have increased predator abundance and effectiveness..." The plan notes that reductions in predation are targeted to contribute to achieving recovery goals for fall Chinook salmon, though net reductions in predation impacts are smaller than those for the habitat, hatcheries, and harvest categories because the impact of predation threats is comparatively less than the other factors. The plan seeks declines in predation among Toutle, Coweeman, Kalama, Lewis, Washougal, Lower Gorge, Upper Gorge, and White salmon populations (eight of the 12 populations affected by the proposed action).

LCR coho salmon. Juvenile and adult LCR coho salmon will be present during the in-water work, and will be exposed to increased suspended sediment, increased contaminant levels, wake stranding, and hydroacoustic effects. Although the in-water work is likely to kill or injure a few juveniles in the area, this will not occur during peak occurrence. As such, only a small number of juveniles will be impacted by the in-water work. The in-water work will overlap with the upstream migration of adults. Adults holding in the vicinity of pile driving are likely to be injured or killed. The loss of a few adults when compared to the loss of a few juveniles has a greater potential to affect the species at the population level. However, the effects of pile driving will only occur during the daylight hours, and will only occur during one season over a 3 month period. Following construction, they will also be exposed to indirect effects including wake stranding, predation, and potential increases in contaminants resultant from coal leachate and coal dust entering the water column.

Juvenile and adult LCR coho salmon will be exposed to OGV traffic year-round. As a result, effects to juveniles will include wake stranding and stress from OGV presence, and effects to adults will include stress from OGV presence. Although the OGV traffic is likely to kill or injure juveniles in the area, the overall percentage of individuals that could be present is small. Therefore, the proposed action, taken with the environmental baseline and cumulative effects, is not likely to appreciably reduce the likelihood of survival and recovery of LCR coho salmon.

CR chum salmon. Because juvenile CR chum move out of the LCR prior to in-water work, we do not expect construction effects to kill or injure juvenile CR chum. Following construction, juvenile CR chum will also be exposed to lethal indirect effects including wake stranding and predation.

Juvenile and adult CR chum salmon will be exposed to OGV traffic during their migrations. As a result, effects to juveniles will include wake stranding and stress from OGV presence, and effects to adults will include stress from OGV presence. Although the OGV traffic is likely to kill or injure juveniles in the area, the overall percentage of chum (compared to LCR chinook) is small because of their rapid migration to the lower estuary. Of the 15 extant populations, almost all natural production occurs in just two populations: the Grays/Chinook (which includes hatchery supplementation) and the Lower Gorge. Based on the location of natal streams, six populations of CR chum from the Cascade stratum are likely to be expose to the permanent effects of the proposed action and effects of its operation and maintenance. These are

- Cascade Cowlitz – fall run; a contributing population with very low baseline abundance (fewer than 300) and a target status for recovery of moderate abundance (900).
- Cowlitz – Summer run; a contributing population with very low baseline abundance (no abundance estimate) and a target status for recovery of moderate abundance (900).
- Kalama; a contributing population with very low baseline abundance (fewer than 100) and a target status for recovery of moderate abundance (900).
- Lewis; a primary population with very low baseline abundance (fewer than 100) and a target status for recovery of high abundance (1300).
- Salmon Creek; a stabilizing population with very low baseline abundance (fewer than 100) and a target status for recovery of very low abundance (no target abundance).
- Washougal; a primary population with very low baseline abundance (fewer than 100) and a target status for recovery of high abundance (1300).

In the Gorge stratum, which contains two populations, the Lower Gorge population (a core and genetic legacy population) has a baseline abundance of 2,000 is targeted for high persistence probability with a target abundance of 2000; and the Upper Gorge population (with a baseline abundance of fewer than 50 fish) is targeted for medium probability of persistence with a target abundance of 900. Both Gorge populations will also be exposed to the permanent effects of the proposed action, and the effects of its operation and maintenance.

The primary limiting factor for these populations is channel condition, including channelization, reduced instream habitat complexity in the Columbia River, and loss of side channels and wetlands in the estuary, and degraded tributary habitats. The first element of the recovery strategy is to protect and improve the Lower Gorge populations. Most of the gains in the viability of Washington chum salmon populations are targeted to be achieved by improving tributary and estuarine habitat. Very large improvements are needed in the persistence probability of almost all chum salmon populations if the ESU is to achieve recovery. More than half of the CR chum populations (8 of 15) will experience presence and operation of the proposed action, every year, for the next 50 years. However, although the OGV traffic is likely to kill or injure juveniles in the area, the overall percentage of individuals that could be present is small. Therefore, the proposed action, taken with the environmental baseline and cumulative effects, is not likely to appreciably reduce the likelihood of survival and recovery of CR chum salmon

LCR steelhead. Juvenile LCR steelhead will be present during the in-water work, and will be exposed to increased suspended sediment, increased contaminant levels, and hydroacoustic effects. Although the in-water work is likely to kill or injure fish in the area, this will not occur during peak occurrence. As such, only a small number of juveniles will be impacted by the in-water work. Following construction, they will also be exposed to indirect effects including wake stranding, predation, and potential increases in contaminants resultant from coal leachate and coal dust entering the water column. Juvenile and adult LCR steelhead will be exposed to OGV traffic year-round. As a result, effects to juveniles will include wake stranding and stress from OGV presence, and effects to adults will include stress from OGV presence. Although the OGV traffic is likely to kill or injure juveniles in the area, the overall percentage of individuals that could be present is small. Therefore, the proposed action, taken with the environmental baseline and cumulative effects, is not likely to appreciably reduce the likelihood of survival and recovery of LCR steelhead.

Eulachon. Juvenile and adult eulachon will be exposed to OGV traffic for approximately 6 months of the year. As a result, effects to juveniles will include wake stranding and stress from OGV presence, and effects to adults will include stress from OGV traffic. Although the OGV traffic is likely to kill or injure juveniles in the area, the overall percentage of individuals that could be present is small. Following construction, Eulachon will also be exposed to indirect effects including wake stranding, predation, and potential increases in contaminants resultant from coal leachate and coal dust entering the water column. Therefore, the proposed action, taken with the environmental baseline and cumulative effects, is not likely to appreciably reduce the likelihood of survival and recovery of eulachon.

Green Sturgeon. Because loss of forage resultant from dredging is expected to last for several months, sub adult and adult green sturgeon will be exposed to temporary loss of forage from dredging. As discussed above, few, if any, green sturgeon are likely to be present within the action area during the period in which dredging is proposed because they are not known to use LCR estuary habitat for rearing except during the late spring through summer months. In the event that green sturgeon that may be present, they are likely to be larger subadults fully able to avoid the dredge head without adverse effects. Green sturgeon are not expected to be present during pile driving.

In summary, the effects of the proposed action are likely to have an adverse impact on PBF conditions that all Pacific salmonids need for forage (prey abundance) and water quality at sites used for freshwater rearing, for free passage and water quality in freshwater migration corridors, and for forage, free passage, and water quality in estuarine areas. Permanent adverse impacts on forage, including shading and habitat displacement from new piles, are intended by the project proponent to be offset by the off-channel slough mitigation site.

The following species will have less exposure to the construction effects because these fish are larger as juveniles when they migrate through the lower Columbia, are less susceptible to the permanent effects such as predation and wake stranding. Therefore we find the effects of the project are unlikely to reduce the likelihood of survival or recovery of the following species: UWR Chinook salmon., UCR Chinook salmon, Snake River spring/summer-run Chinook salmon; Snake River fall-run Chinook salmon; Snake River sockeye salmon; UWR steelhead; MCR steelhead; UCR steelhead; and Snake River Basin steelhead.

Critical Habitat of Listed Fishes. Even though the critical habitat for these species in the Columbia River is limited by poor water quality, altered hydrology, lack of floodplain connectivity and shallow-water habitat, and lack of complex habitat to provide forage and cover, the critical habitat is ranked as having high conservation value because of the critical function it serves to species using it for migration to and from spawning areas. The action area is in an area where the habitat has been degraded due to past land use practices including stormwater runoff and industrial and urban development. The critical habitat in the action area also has a high conservation value for the ESA-listed species covered in this opinion due to its critical role as a migration corridor. Effects on critical habitat from the project are relevant to all salmonids and eulachon that migrate through the action area, including upriver fish listed above.

Adverse effects to the quality and function of critical habitat PBFs and biological and physical features influenced by this project will take place in a small part of the Columbia River, though in an area that all listed fish are will be present in at some point in their life history. The effects on water quality from increased turbidity will be at the highest intensity during the in-water work window. The disturbance of benthic substrates will result in a short-term decrease in forage available to juvenile salmonids. Migration will be disturbed for juvenile and adult salmonids; and adult eulachon for as long as the CET is in place. These temporary and permanent adverse effects to the quality and function of PBFs and physical and biological features when taken together, do not substantially alter the function of the critical habitat at the action area scale, or at the 5th-level HUC scale.

When considered with cumulative effects from climate change and upland human population growth, habitat conditions in the action area are likely to experience chronic diminishments that impede meeting larger recovery objectives.

2.6.2 Marine Mammals

Minimum population estimates of the Eastern North Pacific stock of blue whales is 1,551 individuals and show trends that numbers are increasing, although the mark-recapture estimates show there is no evidence of growth in global populations since the early 1990s. Minimum population estimates of the CA/OR/WA stock of fin whales are 2,598 individuals and show trends that numbers are increasing. Removal of the threat of commercial whaling has allowed increased recruitment in global populations and expected to grow. Minimum population estimates of the CA/OR/WA stock of humpback whales are 1,876 individuals and show an 8 percent increase in numbers. The majority of the stocks in the global populations are also showing trends in increasing numbers of individuals. The minimum population estimate of the CA/OR/WA stock sperm whales is 1,332 individuals. There is no trend information for any of the global populations. In 2012, the North Pacific Ocean sei whale population is estimated to be 29,632 (95 percent confidence intervals 18,576 to 47,267) (International Whaling Commission, 2016; Thomas et al., 2016). Trend information was not available for sei whales.

In this opinion, we identified that blue whales, sei whales, fin whales, humpback whales, and sperm whales may be affected by the marine vessel traffic occurring off the Washington and Oregon coasts.

Marine mammals are known to be injured and harassed by anthropogenic noise sources. There are no sound levels associated with OGV traffic that are likely to cause injury to listed whales; however, whales may be exposed to levels of sound that may cause temporary, short-term disturbance, or behavioral effects during OGV transit. A single individual's exposure to OGV noise is likely to be transient, as all of the whales in the action area are highly migratory, and a single individual is not likely to be within the zone of impact year-round. Although these reactions could increase an individuals' energy budget, the effects are likely to be temporary.

As mentioned in the Environmental Baseline section, threats to whales include ship strikes. Table 36 shows the number of ship strikes to whales off the U.S. West Coast for the years 2007-2011. Additional mortality from ship strikes probably goes unreported because the whales do not strand or, if they do, they do not always have obvious signs of trauma.

As mentioned in the Status of the Species section, under the MMPA, we rely upon the concept of Potential Biological Removal (PBR) to assist or guide decision making about acceptable or appropriate levels of fisheries impacts that marine mammal stocks can withstand.

The proposed project will result in increased risk of ship strikes, and a high likelihood of death, if struck, of fin, humpback, blue, sei, and sperm whales to be struck by OGVs. The future trend in marine shipping is toward a smaller number of ships that are larger in size (Kaplan et al. 2013). Combined with the fact that the Columbia River ports are smaller than other West Coast ports, such as, LA/Long Beach, it is unlikely that this increase in traffic resulting from the CET Longview will substantially increase the average annual ship strike mortality along the West Coast. Cumulative effects are likely to continue to contribute to impaired conditions that affect prey species as PBFs in the proposed CH for humpbacks.

In this opinion, we must consider the impacts from the proposed action on the globally-listed populations of whales. While PBR serves as a useful metric for gauging the relative level of impact on marine mammal stocks as defined in the MMPA, PBR by itself does not equate to a species or population level assessment under the ESA where analyses are conducted at the level of the species listed as threatened or endangered. Global populations of whales covered in this opinion are either not definitive, or are increasing. As with most large whales, removal of the threat of whaling has relieved the primary source of mortality that resulted in reduced population sizes and the listing of these species as endangered. Based on ship strike data from the WCR Stranding Database, the current levels of ship strike and other human-caused mortality for the whales along the coast do not exceed PBR for the MMPA stocks most likely to be affected by the proposed action. While PBR serves as a useful metric for gauging the relative level of impact on marine mammal stocks as defined in the MMPA, PBR does not equate to a species- level assessment under the ESA. Although PBR is likely exceeded for one of the blue whale stocks, there is no evidence to suggest that that stock is either increasing or decreasing. Based on the relatively small level of impact expected from the proposed action and analysis supporting a negligible impact determination for the stocks of whales found off the U.S. West Coast, there is no reason to expect these anticipated impacts would lead to effects on the global populations that would be significant or detectable.

As such, NMFS anticipates that the increased risk of ship strikes on whales is not likely to appreciably reduce the likelihood of survival and recovery of blue, sei, fin, humpback, and sperm whale species.

2.6.3 Leatherback Sea Turtles

Leatherback sea turtles are widely distributed across the oceans of the world and face a variety of threats depending on the region in which they occur. In the marine environment, threats include, but are not limited to, direct harvest, debris entanglement and ingestion, fisheries bycatch, and boat collisions. They are listed as endangered throughout their range. Nesting aggregations in the eastern Pacific occur primarily in Mexico and Costa Rica, and in the western Pacific are found in Indonesia, the Solomon Islands, and Papua New Guinea. Critical habitat is designated in coastal waters adjacent to Sandy Point, St. Croix, in the U.W. Virgin Islands, and along the California coast from Point Arena to Point Arguello east of the 3,000 meter depth contour; and 25,004 square miles (64,760 square km) stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour. Leatherbacks within the action area are most likely to originate from nesting aggregations in the western Pacific. The abundance of leatherback sea turtles is currently unknown but the most recent global estimate for nesting females is 34,500 turtles. The trend for the western Pacific subpopulation has been declining over the past four decades and continues to decline (NMFS 2009b). As mentioned in the Environmental Baseline section, sea turtles have been exposed to noise levels during OGV transit that can cause disturbance, such as decreased ability to monitor its acoustic environment, cause habituation, or sensitization (decreases or increases in behavioral response) (Dow et al. 2012).

The NMFS and USFWS (1998a) recovery plan for leatherback turtles in the U.S. Pacific contains goals and criteria that must be met to achieve recovery for this species. These include research efforts to determine the stock structure of populations and to monitor their status, at least for populations that range into U.S. waters, in part because the abundance goals for leatherback populations in the western Pacific rest primarily on the productivity of nesting beaches.

The proposed project will increase the amount of vessel traffic, and therefore some increased risk of ship strikes. The effects of each encounter may vary from minor (e.g., sound only) to severe (e.g., death due to direct impact). Based on our calculations, OGVs transiting marine waters to and from the CET will result in approximately 2.7 ship interactions with Leatherback Turtles per year. Of these interactions, we expect mortality about 0.47 percent of the time. As such, we estimate approximately one Leatherback turtle to be injured or killed every year (appendix 2). The proposed action will not affect leatherback nesting populations or substantially impair the access of individual turtles to foraging grounds in the Columbia River plume. While climate change as a cumulative effect could be adverse to leatherback nesting areas, this is well outside of the action area. Climate change and other cumulative effects in the action area could alter food webs that serve leatherback turtles, but the range of effects on the conservation value of their CH is difficult to discern in ocean areas.

As we noted earlier, the proposed action will have no adverse effects on the quality of critical habitat for leatherback sea turtles. As such, the proposed action will not impair the conservation role of this critical habitat.

Given the best available information, we conclude that the occasional removal of leatherback turtles from increased vessel traffic is not likely to appreciably reduce the likelihood of survival or recovery of this species.

2.7 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR Chinook salmon, UWR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, Columbia River chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SRB steelhead, Southern green sturgeon, eulachon, fin whales, blue whales, sei whales, sperm whales, humpback whales, or leatherback sea turtles, or destroy or adversely modify designated critical habitat for these species. The proposed project will also not destroy or adversely modify proposed critical habitat of Humpback whales.

2.8 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a 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 further defined by regulation to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering(50 CFR 222.102). Incidental take is defined by regulation as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

This incidental take statement (ITS) provides a take exemption for the action agency and applicant for any take caused by the direct effects of the action. Those direct effects include injury or death caused by predation, pile driving, wake stranding, temporary loss of forage, and harm associated with an increase in suspended sediments.

This ITS provides a take exemption for the action agencies and applicants for any incidental take caused by consequences of the proposed action. This ITS does not include an exemption for any future incidental take of marine mammals caused by third party activities associated with OGV traffic while in the ocean, such as ship strikes on marine mammals from OGVs arriving or departing from the CET for the primary reason that the ESA does not allow NMFS to exempt incidental take of marine mammals where an authorization of the take is required and may be obtained under the MMPA.

2.8.1 Amount or Extent of Take

The proposed project will take place in locations where ESA-listed fish will be present. As described in the effects analysis above, NMFS determined that incidental take of ESA-listed fish is reasonably certain to occur when: (1) Sound pressure waves from pile driving cause physical injury or death to ESA-listed fish in the vicinity of the action; (2) suspended sediment resultant from dredging harm or harass fish present in the action area during work; (3) juvenile salmonids and eulachon[4] become stranded on shore areas adjacent to the river from wakes of OGVs; (4) piscivorous fish predation increases; and (5) loss of forage related to dredging.

This take cannot be accurately quantified as a number of ESA-listed fish because the distribution and abundance of fish that occur within the action area is affected by dam and reservoir operations, habitat quality, interactions with other species, harvest programs, and other influences that cannot be precisely determined by observation or modeling. There is no practicable means to monitor for the number of fish taken through increased predation (fish cannot be counted once consumed), elevated sound levels (fish will move in and out of affected

[4] The NMFS has not yet promulgated an ESA section 4(d) rule prohibiting take of threatened eulachon. Anticipating that such a rule may be issued in the future, we have included a prospective incidental take exemption for eulachon. The elements of this ITS for eulachon would become effective on the date on which any future 4(d) rule prohibiting take of eulachon becomes effective. Nevertheless, the amount and extent of eulachon incidental take, as specified in this statement, will serve as one of the criteria for reinitiation of consultation pursuant to 50 C.F.R. § 402.16(a), if exceeded.

area and harm is not necessarily visible), elevated turbidity (fish will move in and out of the affected area and harm is not necessarily visible), or loss of forage (fish will move in and out of the affected area and harm is not necessarily visible). Therefore, we will not identify the amount of take, but will identify habitat indicators that will serve as surrogates for incidental take. Each of these surrogates (described below) is proportionally related to the numbers of fish expected to be taken and may be effectively monitored, and thus will serve as a meaningful reinitiation trigger.

In addition, the CET facility (an additional activity to the COE proposed action) will increase vessel traffic on the Columbia River by up to 840 OGV round trips per year. In turn, the additional OGV trips are expected to proportionally increase wake stranding events (see Section 2.4.1 of this opinion) and are expected to result in injury and death to juvenile salmonids and eulachon. At this time, there is limited understanding on the variables that contribute to wake stranding events and the limited data associated with wake stranding is considered insufficient to provide an exact take estimate. NMFS' analysis and no jeopardy determination is based on potential wake stranding assuming the maximum number of ship trips associated with the CET facility. NMFS is using the number of OGV trips (which translates to potential wake stranding incidents) as a surrogate for quantifying take consistent with 50 CFR § 402.14(i)(2). Using CET OGV trips as a surrogate establishes a clear standard for determining when the level of anticipated take has been exceeded. For example, if the OGV round trips supported by the new facility exceeds 840 per year then we expect that anticipated effects and resulting take would also be exceeded. Thus, even though the surrogate mirrors the maximum amount of assumed vessel traffic, it nevertheless functions as an effective check on the ongoing validity of the jeopardy analysis (which underpins the take exemption) because it is an annual measurement that can be monitored by the applicant. That means there is an opportunity each year to check whether the assumption of maximum 840 vessels round trips per year has been exceeded. Thus, we believe that OGV trips is an easily assessed, effective and reliable take surrogate that meets the legal standards as they relate to a reinitiation trigger.

For leatherback sea turtles, NMFS is using the same surrogate as for wake stranding, i.e., a maximum of 840 OGV round trips per year. This surrogate is causally linked to the incidental take because the risk of ship strike increases as the number of vessel trips does. In addition, for the reasons set out above with respect to wake stranding, this surrogate establishes a clear standard for determining when the level of anticipated take has been exceeded and functions as an effective check on the ongoing validity of the jeopardy analysis, which underpins the take exemption.

For all whales in this Opinion, the proposed action is reasonably certain to harm individual whales due to vessel traffic associated with operation of the proposed action. The best available incidental take surrogate associated with shipping is the number of OGV round trips per year, i.e. a maximum of 840 OGV round trips per year. This surrogate is causally linked to the incidental take that will occur because an increase in vessel traffic translates into a proportional increase in the risk of ship strike to these species. In addition, for the reasons set out above with respect to wake stranding, this surrogate establishes a clear standard for determining when the level of anticipated take has been exceeded and functions as an effective check on the ongoing validity of the jeopardy analysis, which underpins the take exemption. As explained in the introduction to this section, the ITS does not include an exemption for any future incidental take of marine mammals caused by third party activities associated with OGV traffic.

The best available indicators for the extent of take are:

(1) For harm associated with hydroacoustic impacts to salmon and steelhead from driving the pilings with an impact hammer: the number cumulative hours of pile driving each day. The extent of take for hydroacoustic effects is a maximum of 12 consecutive hours with a 12 hour delay before resuming pile driving. This surrogate is causally linked to incidental take by hydroacoustic impacts because the amount of take increases incrementally with each pile strike and hydroacoustic impacts go back to baseline SELs after a 12 hour delay. It functions as meaningful reinitiation trigger because it can be readily monitored, and so reinitiation could be triggered at any time during the pile driving

(2) For harm associated with increased piscivorous predation on salmon, steelhead, and eulachon, we used the area of shallow water that would be shaded as a habitat surrogate. The extent of take is the coverage by a structure of 13,400 square feet of shallow water habitat. If the portion of the proposed structure in the nearshore (20 feet below the Ordinary High Water Mark to the shore) is larger than 13,400 square feet, the extent of take will be exceeded. This surrogate is causally linked to incidental take by in-water predation because the extent of nearshore shaded coverage correlates with the number of predatory fish that may occupy shaded nearshore areas and thus the amount of incidental take by predation. It functions as an effective reinitiation trigger because it establishes a quantified and measurable surrogate that may be readily monitored to identify any exceedances. Additionally, the Corps has authority to conduct compliance inspections and to take actions to address exceedances, including post-construction. 33 CFR 326.4.

(3) For harm associated with suspended sediment related to dredging to salmon, steelhead and green sturgeon: a 300-foot downstream plume from the point of disturbance based on Washington State Department of Ecology water quality standards (WAC 173-201A-200 (1)(e)). Specifically, if turbidity occurs beyond that authorized mixing zone, the anticipated take would be exceeded. This surrogate is casually linked to incidental take by suspended sediment because the amount of take increases as turbidity increases. It functions as an effective reinitiation trigger because it is a clear, measurable limit that is easily monitored for exceedance, so reinitiation could be triggered at any time during the dredging.

(4) For harm associated with loss of forage related to dredging to salmon, steelhead and green sturgeon. The extent of take is the final area of the dredge prism of 41.5 acres. This surrogate is casually linked to incidental take by loss of forage because the amount of take increases as dredging increases. It functions as an effective reinitiation trigger because it is a clear, measurable limit that is easily monitored for exceedance, so reinitiation could be triggered at any time during the dredging.

(5) For harm associated with wake stranding events to steelhead, salmon and eulachon as well as increased risk of turtle and marine mammal strikes, we used the number of vessels that will

access the CET facility per year. In this case take will be exceeded if more than 840 vessels arrive at the CET operational facility to load coal per year. As explained above, the ITS does not include an exemption for any future incidental take of marine mammals or turtles caused by third party activities associated with OGV traffic.

These features coherently integrate the likely take pathways associated with this action, are proportional to the anticipated amount of take, and are practical and feasible indicators to measure. We expect initial dredge material to be disposed of at Ross Island. This portion of the action is covered by a separate Biological Opinion (WCR-2016-5734), and included in the environmental baseline for this action as impacts from a federal action that has already undergone formal consultation. If the location of dredge disposal from the initial dredge is changed, reinitiation would be required under 50 CFR 402.16(a)(3), as that action would not have been analyzed.

2.8.2 Effect of the Take

In Section 2.7, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.8.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). The Corps and applicant shall minimize incidental take by:

1. Applying permit conditions to avoid or minimize harm to ESA-listed species considered in this opinion.

2. The applicant will (in partnership with others joining to fund implementation of the Wake Stranding Rate Monitoring Plan ("Monitoring Plan")) prepare and submit for NMFS approval a monitoring plan as described in Appendix I within 6 months of the issuance of the COE permit, and will subsequently implement that plan.

3. Ensuring completion of a monitoring and reporting program to confirm that the take exemption for the proposed action is not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the Corps and CET Longview must comply with them in order to implement the reasonable and prudent measures (50 CFR 402.14). The Corps and CET Longview have a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. To implement reasonable and prudent measure #1 (permit conditions), the Corps and applicant shall ensure:

   a. Timing of In-water Work. All piles shall be installed with a vibratory pile driver, except while proofing. Pile driving will be completed over two work years. Pile driving will occur only during the period of September 1 – December 31 in each of the two years. Pile installation with a vibratory hammer will be completed during the period of September 1 - February 28. Dredging will be completed during the period of August 1 - December 31. All work must be completed within these dates.
   b. Pile Driving. Steel piles of 36-inches or less may be installed.
      i. When possible, use a vibratory hammer for pile installation.
      ii. Use a confined bubble curtain or similar sound attenuation system capable of achieving approximately 7 dB of sound attenuation during impact pile driving.
      iii. When impact pile driving, minimize simultaneous pile driving to the extent possible by alternating pile driving between each pile driver, any simultaneous pile driving shall only occur when pile drivers are within 150 feet of each other to minimize effects on listed species.
      iv. When pile driving, minimize cumulative SELs by delaying pile driving 12 hours after each day of pile driving.
   c. Overwater Structure

      Ensure trestle structure in the nearshore does not exceed 0.3 acre (13,400 sf) overwater coverage discussed in this document.

2. To implement reasonable and prudent measure #2, the applicant shall ensure that:

   a. The monitoring plan should be designed to provide details as described in Appendix I to this opinion.
   b. The applicant must submit a draft of the plan within 6-months of the issuance of the COE permit. The applicant must begin implementation of the plan in the first March following the first shipment from the new facility.

3. To implement reasonable and prudent measure #3 (monitoring and reporting), the Corps and applicant shall ensure that:

   a. Visual turbidity monitoring shall be conducted and recorded as described below. Monitoring shall occur each day during daylight hours when dredging is being conducted.
      i. Representative background point. A sample must be taken every two hours at a relatively undisturbed area at least 600 feet up-current from in-water disturbance to establish background turbidity levels for each monitoring cycle. Background turbidity, location, time, and tidal stage must be recorded prior to monitoring downcurrent.
      ii. Compliance point. Monitoring shall occur every two hours approximately 300 feet down current from the point of disturbance and be compared

against the background measurement. The turbidity, location, time, and tidal stage must be recorded for each sample.

iii. Compliance. Results from the compliance points should be compared to the background levels at the corresponding depth taken during that monitoring interval. Turbidity may not exceed an increase of 10 percent above background during the in-water work window.

iv. Exceedance. If an exceedance over the background level occurs, the applicant must modify the activity and continue to monitor every two hours. If an exceedance over the background level continues after the second monitoring interval, the activity must stop until the turbidity levels return to background. If the exceedances continue, then work must be stopped and NMFS notified so that revisions to the BMPs can be evaluated.

v. Fish Use of Mitigation area. A plan to survey fish use in the aquatic mitigation area shall be submitted for NMFS review and approval following project permitting and prior to construction of the mitigation area.

b. Reporting. USACE and the applicant shall report all monitoring items, to include, at a minimum, the following:

ii. Pile installation. Report the number of strikes per pile, the number of piles installed, the type of piles installed, the time between pile installation sessions, the type and use of sound attenuation device, and type of hammer used. Report if pile driving occurs for more than a 12 hour consecutive period.

iii. Turbidity monitoring. Report the results from the turbidity monitoring, including location and time. Report any exceedance of the 300 foot turbidity plume.

iv. Overwater structure. Report the final as-built to ensure trestle structure in the nearshore does not exceed 0.3 acre (13,400 sf) overwater coverage discussed in this document.

v. Dredge area. Report the final area dredged does not exceed 41.5 acres.

vi. Wake Stranding. Report annual wake stranding totals per criteria and methods in the monitoring plan (Appendix 1).

vii. Each annual report must be submitted to NMFS at the following address, or by email to Scott.Anderson@noaa.gov, no later than January 31:

National Marine Fisheries Service
Oregon Washington Coastal Office
Attn: WCRO-2018-00153
510 Desmond Drive, Suite 103
Lacey, Washington 98503

viii. Monitor the number of OGV round trips per year supported by the facility and report immediately to NMFS if the number exceeds 840.

2.9 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). The following conservation recommendation is a discretionary measure that NMFS believes is consistent with this obligation and therefore should be carried out by the Corps or applicants should be encouraged to conduct these activities:

- Work with NMFS, USCG, ports, and industrial facilities on the Columbia River to address the magnitude of wake stranding in the lower Columbia River and implement any discussed solutions to the ship wake stranding issue.
- Work with the USCG and ports to identify marine shipping routes and speeds or maneuvers that reduce the occurrence of wake stranding events.
- Recommend that shipping companies adhere to the NOAA Fisheries West Coast Region Recommendations to Avoid Collisions to minimize the risk of marine mammal and sea turtle ship strikes. Measures include the following:
    - Consult the Local Notices to Mariners in your area or Coast Pilot for more information.
    - Keep a sharp look-out for whales; including posting extra crew on the bow to watch, if possible.
    - Reduce speeds while in the advisory zones, or in areas of high seasonal or local whale abundance.
    - If practicable, re-route vessels to avoid areas of high whale abundance.
    - Report any injured, entangled or ship-struck whales to the 24/7 hotline at (877) SOS-WHALe (767-9425).

Please notify NMFS if the Federal action agency carries out this recommendation so that we will be kept informed of actions that are intended to improve the conservation of listed species or their designated critical habitats.

2.10 Reinitiation of Consultation

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 that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.11 "Not Likely to Adversely Affect" Determinations

Several species of marine mammals and sea turtles have the potential to occur in the Pacific Ocean portion of the action area. The only potential effects from the proposed project would be from interactions with transiting OGVs.

Guadalupe Fur Seals

Guadalupe fur seals occur primarily near Guadalupe Island, Mexico, their primary breeding area. As a non-migratory species, they are only occasionally found north of the U.S.-Mexican border and therefore, their encounter rate with marine vessels in the action area can be considered discountable. In addition, according to the NMFS Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, no human-caused Guadalupe fur seal mortality or serious injuries were reported from non-fisheries sources in 1998-2004. The lack of interactions with ships through reporting or the stranding network lead us to conclude that the exposure risk of collision from OGVs is discountable. Therefore the proposed action is not likely to adversely affect Guadalupe fur seals.

Green Sea Turtles

Green sea turtles use open ocean convergence zones and coastal areas for benthic feeding of macroalgae and sea grasses. There are no known resting areas along the U.S. West Coast. In the eastern North Pacific, green sea turtles commonly occur south of Oregon, but have been sighted as far north as Alaska (NMFS and USFWS 1998b). Stranding reports indicate that the green sea turtle appears to be a resident in waters off San Diego Bay, California (NMFS and USFWS 1998b) and in the San Gabriel River and surrounding waters in Orange and Los Angeles counties, California. Although there is potential for green sea turtles to occur along the Washington and Oregon coasts, available data indicate that occurrence is likely to be rare in the action area. In addition, the increase in the amount of OGV traffic in the ocean portion action area is small (less than 7 percent). Due to the rare occurrence of green sea turtles in the action area, and the small increase in OGV traffic in the action area, it is extremely unlikely there would be an interaction between green sea turtles and OGVs. This leads us to conclude that the risk of ship strikes is discountable. Therefore the proposed action is not likely to adversely affect green sea turtles.

Loggerhead Sea Turtles

Loggerhead sea turtles inhabit continental shelves, bays, estuaries, and lagoons in the Atlantic, Pacific, and Indian Oceans (NMFS and USFWS 1998c). On the U.S. West Coast, most sightings of loggerhead turtles are of juveniles. Most sightings are off California; however there are also a few sighting records from Washington and Alaska (Bane 1992). There are no known resting areas along the U.S. West Coast. Although there is potential for loggerhead sea turtles to occur along the Washington and Oregon coasts, available data indicate that occurrence is likely to be rare in the action area. In addition, the increase in the amount of OGV traffic in the ocean portion of the action area is small. Due to the rare occurrence of loggerhead sea turtles in the action area, and the small increase in OGV traffic in the action area, it is extremely unlikely there would be an interaction between loggerhead sea turtles and OGVs. This leads us to conclude that the risk of ship strikes is discountable. Therefore the proposed action is not likely to adversely affect loggerhead sea turtles.

Olive Ridley Sea Turtles

Olive ridley sea turtles have a mostly pelagic distribution, but they have been observed to inhabit coastal areas. They are the most common and widespread sea turtle in the eastern Pacific. On the U.S. West Coast, they primarily occur off California although stranding records indicate olive ridleys have been killed by gillnets and boat collisions in Oregon and Washington waters (NMFS and USFWS 1998d). In the eastern Pacific, nesting largely occurs off southern Mexico and northern Costa Rica (NMFS and USFWS 1998d). Although there is potential for olive ridley sea turtles to occur along the Washington and Oregon coasts, available data indicate that occurrence is likely to be rare in the action area. In addition, the increase in the amount of OGV traffic in the ocean portion of the action area is small. Due to the rare occurrence of olive ridley sea turtles in the action area, and the small increase in OGV traffic in the action area, it is extremely unlikely there would be an interaction between olive ridley sea turtles and OGVs. This leads us to conclude that the risk of ship strikes is discountable. Therefore the proposed action is not likely to adversely affect olive ridley sea turtles.

North Pacific Right Whales

North Pacific right whales are rarely found off the U.S. West Coast and have primarily been documented foraging in the Bering Sea and the Gulf of Alaska, where critical habitat was designated in 2006. Due to the rare occurrence of North Pacific right whales in the action area it is extremely unlikely there would be an interaction between North Pacific right whales and OGVs from the CET. Therefore, the risk of ship strikes and effects from vessel sound on North Pacific right whales is discountable.

Western North Pacific Gray Whales

Off the Oregon and Washington coasts, the occurrence of Eastern North Pacific gray whales is common, with the most recent population estimate (2015/2016) during southbound surveys being 26,960 (2018 Stock Assessment Report). The Eastern North Pacific stock was delisted from the ESA in 1993, therefore we are not analyzing the Eastern North Pacific stock in this opinion.

Western North Pacific gray whales feed during summer and fall in the Okhotsk Sea off northeast Sakhalin Island, Russia, and in the Bering Sea off southeastern Kamchatka (2018 Stock Assessment Report). The Western North Pacific gray whales are rare, with a population estimate of only 290 individuals (2018 Stock Assessment Report). Recently, information from tagging, photo-identification, and genetic studies show that Western North Pacific gray whales have been observed migrating in the winter to the eastern North Pacific off the outer coast of North America from Vancouver, B.C to Mexico (Lang 2011, Mate *et al.* 2011, Weller *et al.* 2012). Although there is potential for Western North Pacific gray whales to occur in the action area, the available data on their migration patterns and low abundance indicate their occurrence is rare.

Due to the rare occurrence of Western North Pacific gray whales in the action area, it is extremely unlikely there would be an interaction between Western North Pacific gray whales and OGVs from the CET. Therefore, the risk of ship strikes and effects from vessel sound on Western North Pacific gray whales is discountable.

Southern Resident Killer Whales

There are only two confirmed cases of southern resident killer whale injuries and deaths due to boat strikes since 2005 (Carretta *et al*. 2019). There was documentation of a whale-boat collision in Haro Strait (Puget Sound) in 2005 which resulted in a minor injury to a whale. In 2006, whale L98 was killed during a vessel interaction. It is important to note that L98 had become habituated to regularly interacting with vessels during its isolation in Nootka Sound. Both of these collisions were from small vessels. There are two other cases that may or may not be caused by boat strike, but for purposes of this biological opinion (assuming worst-case scenario) we will assume they are. In 2012, a moderately decomposed juvenile female (L-112) was found dead near Long Beach, WA. A full necropsy determined the cause of death was blunt force trauma to the head, however the source of the trauma could not be established (Carretta *et al*. 2019). Similarly, in 2016, a young adult male (J34) was found dead in the northern Georgia Strait. His injuries were consistent with those incurred during a vessel strike, though a final determination has not been made (Carretta *et al*. 2019).

From 1982-2016, there were 49 confirmed sightings of southern resident killer whales in coastal waters off the western U.S. No documented southern resident killer whale deaths or strandings have occurred near the action area. The relatively small action area, low presence of killer whale in the action area, and the lack of interactions with large ships through reporting or the stranding network, with none near the action area, leads us to conclude that risk of collision from vessels is discountable. The sound from OGVs is largely low frequency sound that does not overlap with the most sensitive hearing range of killer whales. Vessel sound may still be audible to the whales, but any disturbance from the sound of passing OGVs is expected to be short-term, transitory, and insignificant. Therefore, acoustic effects of the proposed action will be insignificant on southern resident killer whales and proposed southern resident killer whale critical habitat.

The proposed action may affect southern resident killer whale s indirectly by reducing availability of their primary prey, Chinook salmon. The proposed activities are not expected to produce a measurable effect on the abundance, distribution, diversity, or productivity of Chinook salmon at either the population or species level. Given the total quantity of prey available to southern resident killer whales throughout their range, this reduction in prey is extremely small, and is not anticipated to be different from zero by multiple decimal places (based on NMFS previous analyses of the effects of in-river salmon harvest on Southern Resident killer whales, e.g. NMFS No. WCR-2017-7164). Because the reduction is so small, there is also a low probability that any juvenile Chinook salmon killed by the proposed activities would have later (in 3-5 years' time) been intercepted by the killer whales across their vast range in the absence of the proposed activities. Therefore, the anticipated reduction of salmonids associated with the proposed action would result in an insignificant reduction in adult equivalent prey resources for southern resident killer whales and an insignificant effect on proposed southern resident killer whale critical habitat.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Adverse effects occur when EFH quality or quantity is reduced by a direct or indirect physical, chemical, or biological alteration of the waters or substrate, or by the loss of (or injury to) benthic organisms, prey species and their habitat, or other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific coast groundfish (PFMC 2005; PFMC 2019), and Pacific coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction section to this document. The action area includes areas designated as EFH for various life-history stages of groundfish, and Chinook and coho salmon.

3.2 Adverse Effects on Essential Fish Habitat

We conclude that the proposed action will have the following adverse effects on EFH designated for groundfish, coho, and Chinook salmon:

- Short-term increase in underwater noise from installation of steel pipe piles using an impact hammer.
- Short-term increase in contaminants from construction machinery in close proximity to the Columbia River.
- Short-term increase in suspended sediment from pile installation and dredging.
- Long-term increase in contaminants from increased ship traffic.
- Long-term loss of habitat from placement of 531, 36” piles resulting in long-term loss of 3791sf of habitat.
- Long-term shading of 13,400 sf of shallow-water habitat from overwater structure.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS expects that fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2 above, approximately 6,220,799 acres of designated EFH for Pacific Coast salmon and groundfish.

To reduce the effects of sound pressure levels in aquatic habitat the Corps should ensure that:

Pile installation with an impact hammer, occurs only during the period of September 1 – December 31. Pile installation with a vibratory hammer will be completed during the period of September 1 - February 28. Only steel piles of 36-inches or less are installed.

i. When possible, use a vibratory hammer for pile installation.
ii. Use a confined bubble curtain or similar sound attenuation system capable of achieving approximately 7 dB of sound attenuation during impact pile driving.
iii. When impact pile driving, minimize simultaneous pile driving to the extent possible by alternating pile driving between each pile driver, any simultaneous pile driving shall only occur when pile drivers are within 150 feet of each other to minimize effects on listed species.

To ensure that turbidity effects on water quality are kept to a minimum, visual turbidity monitoring shall be conducted and recorded as described below. Monitoring shall occur each day during daylight hours when dredging is being conducted.

i. Representative background point. A sample must be taken every 2 hours at a relatively undisturbed area at least 600 feet up-current from in-water disturbance to establish background turbidity levels for each monitoring cycle. Background turbidity, location, time, and tidal stage must be recorded prior to monitoring downcurrent.
ii. Compliance point. Monitoring shall occur every 2 hours approximately 300 feet down current from the point of disturbance and be compared against the background measurement. The turbidity, location, time, and tidal stage must be recorded for each sample.
iii. Compliance. Results from the compliance points should be compared to the background levels at the corresponding depth taken during that monitoring interval. Turbidity may not exceed an increase of 10 percent above background during the in-water work window.
iv. Exceedance. If an exceedance over the background level occurs, the applicant must modify the activity and continue to monitor every 2 hours. If an exceedance over the background level continues after the second monitoring interval, the activity must stop until the turbidity levels return to background. If the exceedances continue, then work must be stopped and NMFS notified so that revisions to the BMPs can be evaluated.
v. Fish Use of Mitigation area. A plan to survey of fish use in the aquatic mitigation area shall be submitted for NMFS review following project permitting and prior to construction of the mitigation area.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Corps must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The DQA specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Corps and applicant, and interested members of the public such as fishing groups, outdoor recreation groups, and conservation groups. Individual copies of this opinion were provided to the Corps. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01, et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

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

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

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

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APPENDIX 1. Monitoring Plan for Wake Stranding

The applicant will fund, either individually or with others, a study to re-examine the rates of fish stranding at three sites along the Columbia River. The objective of the study is to add to the knowledge of stranding rates at Barlow Point, County Line Park, Sauvie Island, and other sites that may fit the physical criteria for wake stranding. The applicant will work collaboratively with NMFS to develop additional details of the observation sampling program. The applicant will submit a draft of the sampling study protocol within four (6) months of issuance of the Corps permit.

Monitoring will occur at the known stranding locations at Barlow Point, County Line Park and Sauvie Island. Fish stranding observation methods will replicate the efforts of Pearson et al., 2006 and the Wapato Mitigation Bank, although current technology will be employed to increase information and focus efforts. Beach seining to determine fish abundance adjacent to the known stranding locations will be included on each observation day.

The study will include an observation at a high risk stranding beach other than Sauvie Island. This will be an informal observation conducted once during the course of each sampling year. The purpose of this study element is to expand the knowledge of the prevalence of stranding at beaches predicted to have high stranding risk.

The study effort will include thirty (30) total days of observations (10 days at each of three beaches) per year over a 7-month period (March through September). The study will be conducted in years 1, 3, and 5, with year zero being the first March after product shipment from the new facility is initiated. Initiation of the study can be delayed by two (2) additional years if the delay would allow applicants from other projects to participate in funding the study. Initiation of the study is also subject to obtaining any necessary scientific permits or other necessary regulatory approvals.

If others join to fund the study, additional effort will be added to: 1) develop a proposed study to more accurately assess the highly susceptible beaches as defined by Pearson et al to provide broader coverage beyond the known stranding location hotspot so that a more accurate average stranding rate can be calculated throughout the Lower Columbia River, and 2) implement such study.

APPENDIX 2. Piscivorous Predation Model

Background

As we did not find literature reporting on predation effects associated with docks within the Lower Columbia River, we assume that empirical predation results from other areas of the Columbia River and laboratory studies provide a reasonable surrogate for the interpretation of predation related effects. In the Columbia River, out-migrating juvenile salmon are a seasonally important part of the diet of piscivorous predators including northern pikeminnow and smallmouth bass. Historically, pikeminnow accounted for approximately 78 percent of total salmonid losses to piscivorous predation in the Columbia River (Rieman *et al.*, 1991). In nearshore areas of the Columbia River, including four sampling sites below Bonneville dam, more than 84 percent of fish consumed by pikeminnow were juvenile salmonids, regardless of river reach and season (Zimmerman and Ward, 1999).

We utilized published peer-reviewed and technical reports of field and laboratory studies to predict likely predation of ESA-listed salmonid smolts, with and without the new, proposed structures. Pikeminnow predation predictions (expressed as a total number of juveniles consumed from April-August) were generated using calculated average abundances over a 17 year duration (Williams *et al.* 2018), calculated consumption rates based upon published consumption indexes in proximity to the action area (reported as an average [Friesen and Ward, 1999, Appendix, Williams *et al.* 2018]), and an exponential decay function published by Petersen and Gadomski (1994) which predicts the predation success of pikeminnow under varying light intensities. Key assumptions are presented in Table A1 and the conceptual model including equations, supporting material, and calculations are described below.

Table A1. Assumptions of the predation model, identifying which variable is influenced by the assumption.

Assumption	Variable(s) Influenced
1. Habitat is uniformly occupied by northern pikeminnow, and not limited by water velocity	Density
2. Pikeminnow age classes are randomly dispersed	Density, Consumption
3. Pikeminnow consumption is equal across habitats and age classes	Consumption
4. Prey (juvenile salmon smolts) are equally available to all predators	Consumption
5. Turbidity is constant throughout the outmigration	Light Intensity
6. Water stage height is constant throughout the outmigration	Light Intensity
7. Dock shading effects are only realized on sunny days	Light Intensity
8. Structures with no light penetration are assumed to have 1 percent light penetration	Light Intensity

Northern Pikeminnow Abundance Estimate

Published abundance estimates for pikeminnow within the Columbia River are outdated, and were estimated prior to the implementation of the pikeminnow sport fishery reward program (Beamesderfer *et al.*, 1996, Zimmerman and Ward, 1999). The purpose of this reward program is to remove pikeminnows in size classes known to predate juvenile salmoinds (>200mm; TL), during juvenile salmon outmigration. Removal of pikeminnows increases the outmigration survival probability of juvenile salmonids. Using exploitation data published by the pikeminnow reward program (Annual Reports from 2000-2017; http://www.pikeminnow.org/project-reports-2/annual-reports), it was possible to estimate an average abundance of pikeminnow occupying Columbia River below Bonneville Dam from 2000-2017 ($\bar{x}$ = 586,278, sd= 197,141, range 305,034-997,869), using the following equation:

$$\frac{[\sum_{i}^{2017} NH_i/ER_i]}{2017-i}$$

Where:

NH= number of pikeminnows harvested Below Bonneville Dam in year i
ER= exploitation rate (expressed as a decimal percent) of pikeminnow in year i

Northern Pikeminnow Habitat Availability and Density

The 17 year average abundance estimate (calculated above) was used to calculate a density of northern pikeminnow (pikeminnow/square meter), occupying the shallow water habitats of the Columbia River below Bonneville Dam. For this analysis shallow shoreline habitats were defined as aquatic habitat with depths ranging from 0.5 - 13m, as pike minnows are rarely found in depths outside that range (Ward *et al*. 1995). Pikeminnow density was utilized within this effects analysis to estimate how many pikeminnows would associate with the shaded area under the proposed trestle. Spatial analysis techniques were utilized within ArcGIS (Version 10.5.1; ESRI 2011), to calculate the total amount of aquatic habitat with depths ranging from 0.5-13m. The Lower Columbia Digital Terrain Model was acquired from the Lower Columbia Estuary Partnership (estuarypartnership.org), this bathymetric model of the lower Columbia River, is the best available depth profile, incorporating NOAA acoustic multi-beam sonar, bathymetric surveys from 2008-2009, US Army Corps of Engineers crossline and channel bathymetric surveys from 2000-2009, and topographical LiDAR surveys from 2009-2010, and Lower Columbia Estuary Partnership shallow water bathymetric surveys from 2009-2010. This raster dataset is high resolution with $1m^2$ grid cells, and can be seen in Figure A1. Preferred pikeminnow depths (0.5-13m) were extracted from the bathymetric dataset to determine that $153,442,900m^2$ of available pikeminnow habitat is below the Bonneville Dam as displayed in Figure A2, which results in a density of 0.0038 pikeminnow per square meter of habitat.

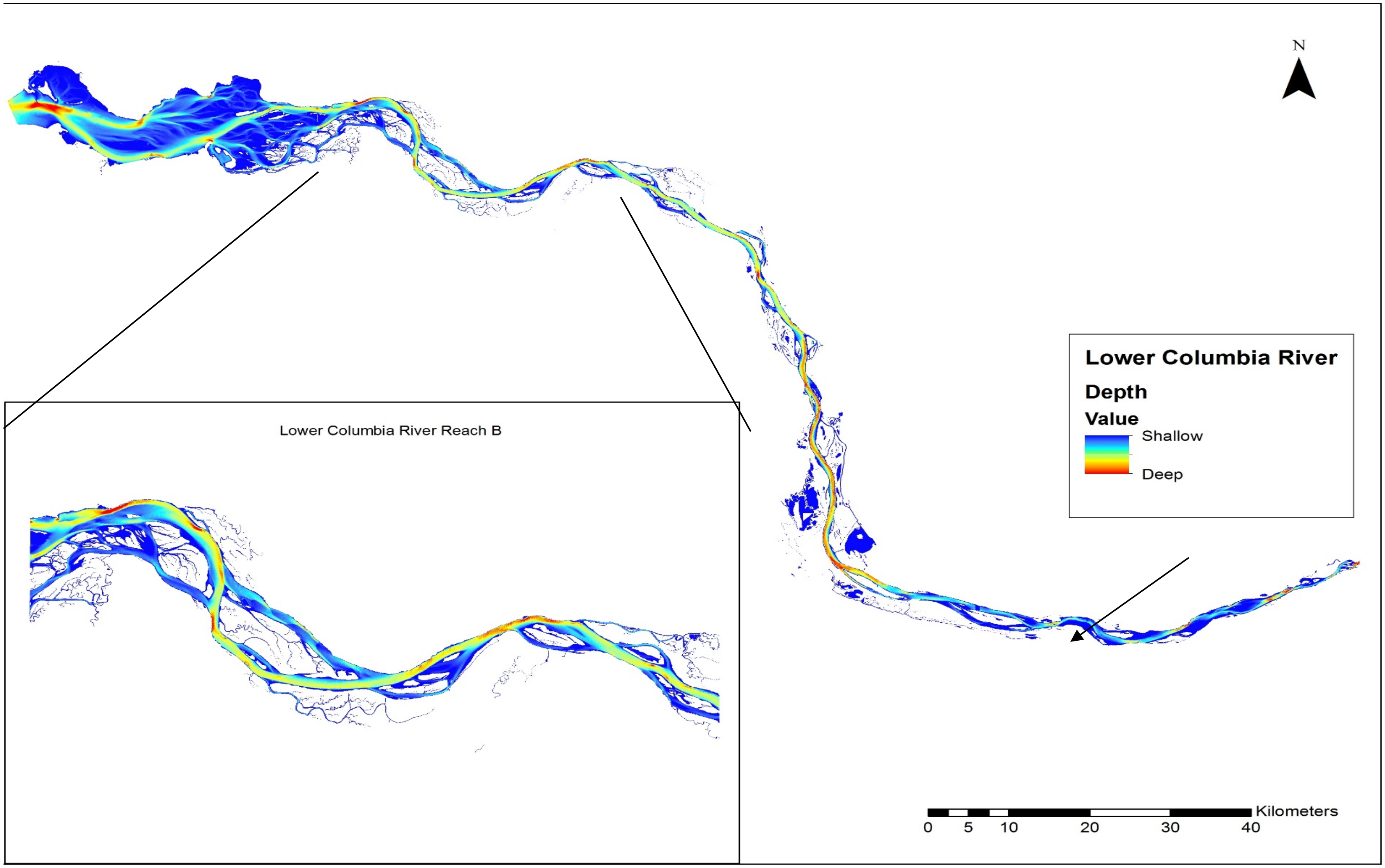

Figure A1. High resolution bathymetric map of the LCR used to calculate available pikeminnow habitat based upon known depth preferences. Reach B is emphasized for clarity, and because it's the lowest reach in the LCR with known pikeminnow presence due to saltwater inundation.

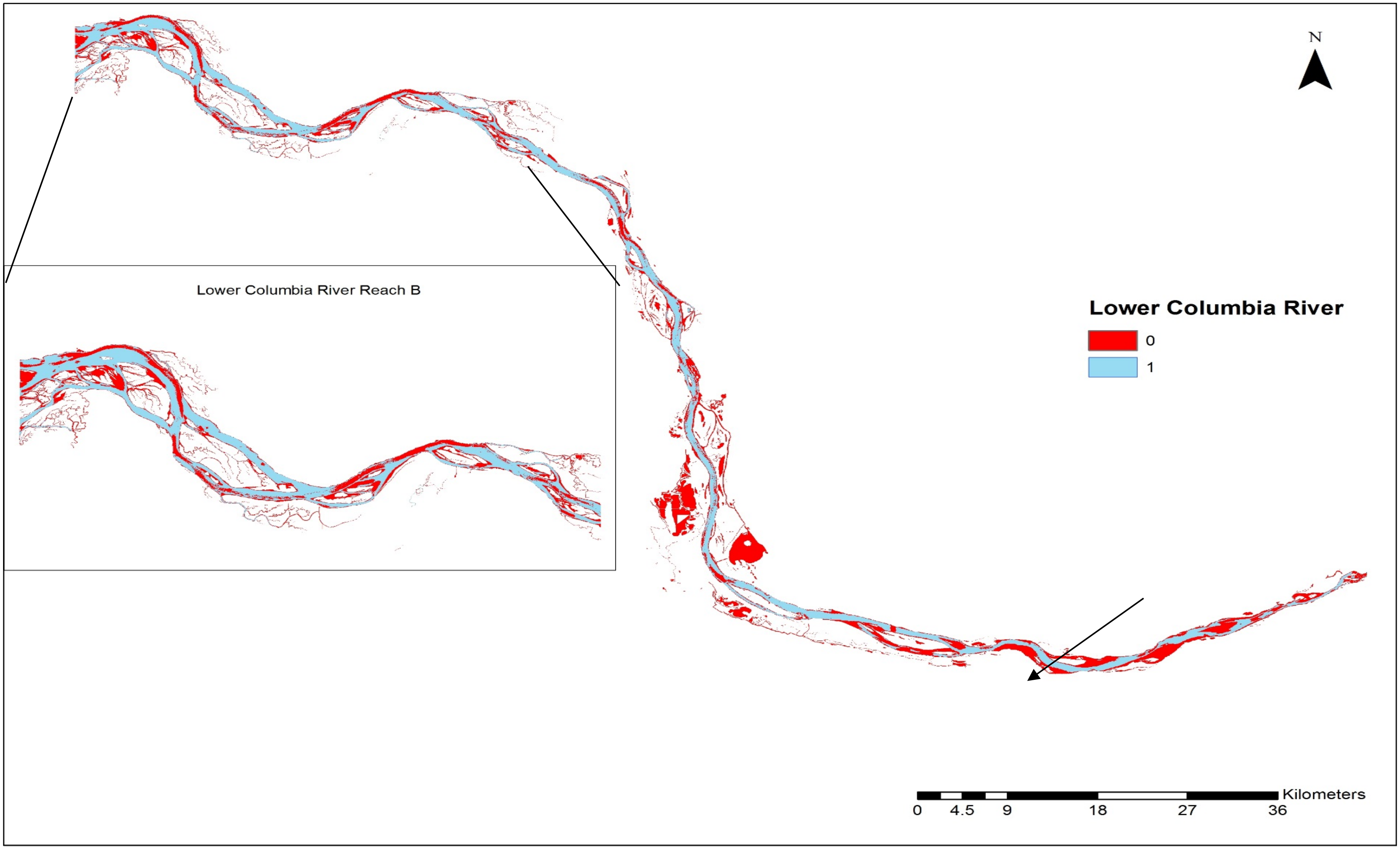

Figure A2. Habitat suitability map for northern pikeminnow in the LCR. Values of zero (red) represent areas that are either too shallow or too deep to be occupied by pike minnow, values of one (blue) are suitable habitats based solely upon depth.

Pikeminnow Consumption Index and Light Intensity Related Consumption

To estimate the average number of juvenile salmonids that could be consumed by pikeminnow we used recently published consumption index values (Williams *et al.* 2018) to calculate a mean consumption index (1.152) of northern pikeminnow in closest proximity to the action area, as consumption rates can vary by location (Zimmerman and Ward, 1999). To convert the mean consumption index to a consumption rate related to this project we used the relationship: consumption = -0.077+0.618 * Consumption Index [CI] (Friesen and Ward, 1999, Appendix). Thus, we calculated the consumption rate (CR) of 0.6349 juvenile salmon per pikeminnow per day across the April-August outmigration period.

Predation is, in part, regulated by light intensity, as foraging in aquatic habitats often involves light-mediated mechanisms whereby fish are able to identify and respond appropriately to prey and predator encounters. Petersen and Gadomski (1994) found the rate of predation by northern pikeminnow on subyearling Chinook salmon was inversely related to light intensity in laboratory studies, and five times more salmon were eaten in the darker than in the lighter conditions. Results of the model presented by Petersen and Gadomski (1994) were expressed as an exponential decay function predicting the number of juvenile salmon eaten over 4 hours under varying light intensity by northern pikeminnow. The exponential decay function published by Petersen and Gadomski is as follows and can be viewed graphically in Figure A3:

$$PE = 0.144 * \ e^{-0.61*\ln(LI)}$$

Where:
PE = prey eaten
LI = light intensity

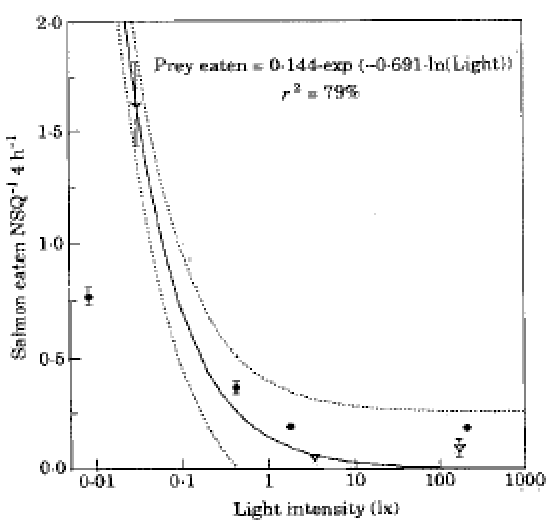

Figure A3. Exponential decay function from Petersen and Gadomski (1994)

Using the exponential decay function described above, the model input of LI, was varied by calculating the reduction in light intensity under the proposed dock when compared to the same area with no dock. By varying LI it was possible to calculate the difference in juvenile salmon predation success with and without the proposed structures. This difference was transformed to reflect consumption by pikeminnow over 24 hours as the decay function was calculated for 4 hour predation windows, the transformed consumption was then added to the consumption rate of pikeminnow within the action area. Reduction in light intensity due to shading under the dock was calculated using a standard light annulation in water equation expressed below:

$$I_z = I_0 e^{-(K_w + K_p)^z}$$

Where:

I_z = Light intensity at depth z
I_o = Light intensity at surface
K_w= Light extinction do to water scatter
K_p= Light extinction due to dissolved particles (e.g. turbidity)

To calculate the difference with and without the proposed structures we varied I_o in the above equation, while keeping all other variables constant. To do so we assumed that the light intensity at the water surface under the dock would be a function of the amount of sunlight able to penetrate the docks surface. Using the calculated light intensity values at depth with and without the proposed structure, as the LI variable within the exponential decay function described above we could determine the difference in predated juvenile salmon between conditions.

We assumed that reduced light intensity will only be significant on sunny days, and shading effects would be negligible on cloudy days. Historical NOAA climate data from the last 30 years (http://w2.weather.gov/climate/xmacis.php?wfo=pqr) from Portland, Oregon located approximately 40 miles upriver of the action area reports and average of 1,417 sun hours during the months of April-August. Dividing the total number of sun hours by 24 hours we calculated the number of “sun days” (59), likely to occur within the action area during juvenile salmon outmigration, which would be equivalent to the number of days the shading effects of the dock will increase the predation efficiency of pikeminnow.

Finally, to calculate the difference in predation by pike minnow under the proposed structure due to shading the following equation was used:

$$PI_i = D(CR + LIP_i) * SD - (D * CR) * SD$$

Where:
PI_i = Predation increase under structure i
CR= Pikeminnow consumption rate
LIP_i = Light related increased predation under structure i
D= Density of pikeminnow associated with area of structure
SD= Sun days

Density and consumption rates were consistent on both sides of the equation, as predation of juvenile salmon was assumed to occur in the action area regardless of the structure being present or not. However, the reduced light intensity increase in consumption rate was added to the consumption rate of pikeminnow to estimate the additional number of smolts predated by pikeminnow due to better foraging conditions created by the shading of the dock. Assuming the structure has a life of 40 years, a total amount of increased predation can be calculated.

Finally to highlight the sensitivity of the variables utilized to estimate predation losses. We varied one or a combination of density, consumption, and light intensity to identify which variable was the most sensitive resulting in greater predation losses. As shown in Table A2 light intensity is the most sensitive followed by density, consumption is the least sensitive.

Table A2. Predation differences highlighting variable sensitivity of density, consumption rate, and light intensity values. All were calculated for a 1000 sq/ft structure in 3meters of water with a constant turbidity value of 1.2 NTU. Mean values for density and consumption are calculated means presented above.

Scenario	Density	Consumption	Light Intensity	No Structure Present	Structure Present	Difference
Mean	0.004	0.635	0.5	13	18	5
Density Low	0.002	0.635	0.5	7	9	2
Density High	0.008	0.635	0.5	26	35	9
Consumption Low	0.004	0.317	0.5	7	11	4
Consumption High	0.004	1.270	0.5	27	31	4
Light Intensity Reduction Low	0.004	0.635	0.9	13	14	1
Light Intensity Reduction High	0.004	0.635	0.1	13	29	16
All Low	0.002	0.317	0.9	3	4	1
All High	0.008	1.270	0.1	53	83	30

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APPENDIX 3. Estimation of whale and leatherback sea turtle collisions

We estimated the density distribution along an east to west line across the EEZ (N(x), whales per 100 square kilometers per mile) of humpback whales, fin whales, and leatherback turtles in the EEZ off of the coast of Washington State from Figure 3 in (Rockwood et al., 2017). We converted this density to whales per square mile per mile by dividing it by 38.6 square miles per 100 square kilometers. (Koopman, 1956) assumes that targets (in this case, whales and turtles) are moving at a constant speed u in a random direction φ with respect to the OGV. Whales can swim up to 30 miles per hour, and cruise at 12 miles per hour. We set the velocity *u* at 2 miles per hour for humpback and fin whales (Lagerquist et al., 2008; Schorr et al., 2010) and 1 miles per hour for turtles (higher velocities increase the number of encounters and mortalities). We set the speed of the OGV *v* at 15 miles per hour. We set the width of the OGV to 32 meters so the radius *R* of the encounter circle is 16 meters or 0.02 miles.

The EEZ is 200 miles wide. OGVs at 15 miles per hour travel one mile in 0.067 hours. The BA proposes up to 840 OGVs per year. Fin whales are in the EEZ off of the coast of Washington all year and are exposed to all 840 CET OGVs. Humpback whales and fin whales are only in the EEZ off the coast of Washington for six months of the year and are exposed to 420 CET OGVs.

The frame of reference moves with the CET OGV at 15 miles per hour. The relative velocity of the whale ***w*** is the vector sum of the OGV velocity and the actual whale velocity. From the law of cosines, the magnitude of **w** is:

$$w = \sqrt{u^2 + v^2 - 2uvcos\varphi}$$

Since the direction of each whale is random, the number of whales in each mile swimming in a direction between track angles φ and φ+dφ is $\frac{N(x)d\varphi}{2\pi}$. For any whale direction φ, the only whales that can enter the OGV encounter circle per hour are in the ocean area $2Rw$ so the number of whales between φ and φ+dφ that can enter the encounter circle per mile is $2TRwN(x)\frac{d\varphi}{2\pi}$ where T is the time it takes for the OGV to travel one mile (.067 hours). The total number of whales that can enter the encounter circle per hour is:

$$N_o = \frac{R}{\pi}\int_0^{200} TN(x)\int_0^{2\pi} wd\varphi dx$$

Although the integral $\int_0^{2\pi} wd\varphi$ has an infinite series solution, we evaluated it in an Excel spreadsheet with $\Delta\varphi = \frac{2\pi}{32}$ and then summed $TN(x)\int_0^{2\pi} wd\varphi$ in one mile steps over the 200 mile width of the EEZ.

The number of whales that enter the encounter circle per year is:

$N_o\ x\ 420\ or\ 840\ trips\ per\ year$. The number of whales killed is the enter the encounter zone that are killed is equal to the number of whales that enter encounter circles per year times the fraction of time whales are at a depth above the bottom of the OGV (0.7) (Rockwood et al., 2017)times the probability that the whale will not take action to avoid collision (0.45) (McKenna et al., 2015) times the probability that the whale will be killed at the 15 mile per hour velocity of the OGV (0.8) (Conn and Silber, 2013).

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