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-2020-02918

June 16, 2021

Christopher Page
Chief, Environmental Resources Branch
United States Army Corps of Engineers
Portland District
333 SW 1st Ave.
Portland, Oregon 97204

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Operations and Maintenance Dredging of the Federal Navigation Channel at Tongue Point, Clatsop County, Oregon; Elochoman Slough, Wahkiakum County, Washington; Lake River, Clark County, Washington; and Oregon Slough, Multnomah County, Oregon.

Dear Mr. Page:

Thank you for your letter of October 16, 2020, 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 operations and maintenance dredging of the four Federal navigation channels referenced above. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

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 (16 U.S.C. 1855(b)) for this action.

In the attached biological opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of:

- *Oncorhynchus tshawytscha:* Lower Columbia River (LCR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, SR (SR) spring/summer Chinook salmon, Upper Willamette River (UWR) Chinook salmon, Snake River fall Chinook salmon;
- *O. keta:* Columbia River (CR) chum salmon;
- *O. kisutch:* LCR coho salmon;
- *O. nerka:* SR sockeye salmon;
- *O. mykiss:* UCR steelhead (*O. mykiss*), LCR steelhead, UWR steelhead, Middle Columbia River (MCR) steelhead, Snake River Basin (SRB) steelhead;

- *Acipenser medirostris:* Southern DPS green sturgeon; or
- *Thaleichthys pacificus:* Southern DPS Pacific eulachon;

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

As required by section 7 of the ESA, NMFS is providing an incidental take statement with the biological 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 U.S. Army Corps of Engineers or any applicant 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.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes six conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. 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.

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.

If the response is inconsistent with the EFH conservation recommendations, the Corps 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.

Please contact Scott Hecht, Branch Chief, Oregon Washington Coastal Area Office in Lacey, Washington, 360-545-7490, Scott.Hecht@noaa.gov, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Elizabeth Santana
David Griffith

WCRO-2020-02918

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

Federal Navigation Channel Operations and Maintenance Dredging
Tongue Point, Clatsop County, Oregon
Elochoman Slough, Wahkiakum County, Washington
Lake River, Clark County, Washington
and
Oregon Slough, Multnomah County, Oregon

NMFS Consultation Number: WCRO-2020-02918

Action Agency: U.S. Army Corps of Engineers – Portland District

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Chinook salmon *(Oncorhynchus tshawytscha)*					
Lower Columbia River Chinook salmon	Threatened	Yes	No	Yes	No
Upper Columbia River spring-run Chinook salmon	Endangered	Yes	No	Yes	No
Snake River spring/summer Chinook salmon	Threatened	Yes	No	Yes	No
Upper Willamette River Chinook salmon	Threatened	Yes	No	Yes	No
Snake River fall Chinook salmon	Threatened	Yes	No	Yes	No
Columbia River chum salmon (*O. keta*)	Threatened	Yes	No	Yes	No
Lower Columbia River coho salmon (*O. kisutch*)	Threatened	Yes	No	Yes	No
Snake River sockeye salmon (*O. nerka*)	Endangered	Yes	No	Yes	No

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Upper Columbia River steelhead *(Oncorhynchus mykiss)*	Threatened	Yes	No	Yes	No
Lower Columbia River steelhead	Threatened	Yes	No	Yes	No
Upper Willamette River steelhead	Threatened	Yes	No	Yes	No
Middle Columbia River steelhead	Threatened	Yes	No	Yes	No
Snake River Basin steelhead	Threatened	Yes	No	Yes	No
Southern DPS of green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No
Southern DPS of Pacific eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Pacific Coast Groundfish	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: June 16, 2021

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

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 this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Oregon Washington Coastal Office in Lacey, Washington.

1.2. Consultation History

This biological opinion is in response to the U.S. Army Corps of Engineers – Portland District (USACE) request for formal consultation on ESA listed species detailed in Table 1 for maintenance dredging of four navigation side channels.[1] The USACE also requested consultation on Essential Fish Habitat (EFH) for Pacific salmon. Although the USACE did not request consultation on EFH for West Coast groundfish, we know that some of these are present in a portion of the action area and provide an effects analysis in Section 3. The USACE's proposed maintenance dredging and in-water placement of the dredged sediments will be conducted under Sections 102 and 103 of the Marine Protection Reserve and Sanctuaries Act (MPRSA) of 1972, Sections 401 and 404 of the Clean Water Act (CWA) of 1977, and in accordance with Regulations 33 CFR Parts 335 through 338 ("Operation and Maintenance of Army Corps of Engineers Civil Works Projects Involving Discharge of Dredged or Fill Material into Waters of the U.S. or Ocean Waters" and affiliated procedures, etc.).

[1] The USACE's original request for formal consultation did not include SDPS green sturgeon or SDPS eulachon, or their designated critical habitat, which the USACE considered not likely to be adversely affected (NLAA). NMFS considers these resources likely to be adversely affected, and includes them in the table and in the formal consultation.

On October 16, 2020, NMFS received the USACE's request for consultation and the Biological Assessment (BA) (USACE 2021):

- On November 17, 2020, NMFS sent an insufficiency letter to the USACE. NMFS' project biologist worked with the USACE's project lead to identify the missing information over the next few weeks.
- On December 17, 2020, NMFS received the revised BA and notified USACE that it was initiating consultation.
- On February 24, 2021, NMFS sent letters to the Columbia River Inter-Tribal Fish Commission, the Confederated Tribes of the Umatilla Reservation, Confederated Tribes of the Warms Springs Reservation of Oregon, Cowlitz Indian Tribe, Confederated Tribes and Bands of the Yakama Indian Reservation, the Nez Perce Indian Tribe, and the Confederated Tribes of the Siletz Indians of Oregon to gauge their interest in this project on.
- On March 11, 2021, NMFS received a letter from the Nez Perce Tribe asking for more information about the project. The Tribe was interested in NOAA's analytical method for assessing effects of the proposed action on listed fish, and the likelihood that toxic materials would be mobilized during flow lane disposal of excavated sediments. They also expressed concern about juvenile lamprey, stating that the Tribe has requested, for other dredging activity, that monitoring take place to identify the presence of lamprey in the dredging areas, along with monitoring of the dredge spoils as it is loaded on the barge. Should lamprey be present, a work-around plan should be implemented to avoid harm to the species. NMFS, USACE, and USFWS (for lamprey concerns), met with the Tribe on April 19, 2021, to discuss these concerns.
- On March 12, 2021, NMFS received an email from Amy Boyd, a Policy Analyst with the Cowlitz Indian Tribe, stating that the Tribe would like to provide feedback regarding natural and cultural resources. NMFS offered the Tribe an opportunity to provide this feedback during a web-based meeting on March 29, 2021.
- On May 17, 2021, NMFS and the USACE discussed concerns about the potential frequency of dredging in the Elochoman Slough and Lake River channels and the need to better understand effects on benthic prey organisms for salmonids. As a result, the USACE revised its proposed action to reduce the frequency of dredging in these two project areas to no more than once every three years.
- During consultation, the USACE amended its BA in response to our questions about the maximum volume of sediment to be dredged from each side channel and their turbidity monitoring and management actions. We received draft amendments on April 14, 15, 16; May 25, 2021, and the final amended BA (USACE 2021) on June 7, 2021.

Table 1. List of species included in the consultation for the maintenance dredging of four side channels that are part of the Federal Navigation Channel.

ESU or DPS Species	Listing Notice	Listing Status	Critical Habitat Listing
LCR[a] Chinook salmon	6/28/2005; 70 FR 37160	Threatened	9/2/2005; 70 FR 52630
UCR[a] Chinook salmon	6/28/2005; 70 FR 37160	Endangered	9/2/2005; 70 FR 52630
SR[a] spring/summer Chinook salmon	6/28/2005; 70 FR 37160	Threatened	10/25/1999; 64 FR 57399
UWR[a] Chinook salmon	6/28/2005; 70 FR 37160	Threatened	9/2/2005; 70 FR 52630
SR fall Chinook salmon	6/28/2005; 70 FR 37160	Threatened	10/25/1999; 64 FR 57399
CR[a] chum salmon	6/28/2005; 70 FR 37160	Threatened	9/2/2005; 70 FR 52630
LCR coho salmon	6/28/2005; 70 FR 37160	Threatened	2/24/2016; 81 FR 9252
SR sockeye salmon	4/14/2014; 79 FR 20802	Endangered	12/28/1993; 58 FR 68543
UCR steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
LCR steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
UWR steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
MCR[a] steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
SRB[a] steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005; 70 FR 52630
Southern DPS of green sturgeon	4/7/2006; 71 FR 17757	Threatened	10/9/2009; 74 FR 52300
Southern DPS of eulachon	3/18/2010; 75 FR 13012	Threatened	10/20/2011; 76FR 65324

[a] LCR: Lower Columbia River; UCR: Upper Columbia River; SR: Snake River; UWR: Upper Willamette River; CR: Columbia River; MCR: Middle Columbia River; SRB: Snake River Basin.

1.3. Proposed Federal Action

Under the ESA, "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). Under MSA, 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).

The USACE proposes maintenance dredging in four side channels of the lower Columbia River Federal navigation channel (FNC) over a period of 25 years (USACE 2021). The USACE proposes to dredge the Tongue Point, Oregon, channel annually, but expects to dredge the other three sites (Elochoman Slough and Lake River, Washington, and Oregon Slough, Oregon) an average once every 5 years. For example, the USACE could dredge at any of the three sites 2 years in a row depending on changes in shoaling over time, dredging priorities, and available funding, but will not dredge any of them more than five times over the term of the proposed action (USACE 2021).

The dimensions of each dredging prism are shown in Table 2 and the dredging prisms themselves are shown in Figures 1 through 4. The USACE expects to dredge areas only that have become too shallow within each prism during any dredging event, but cannot predict where this will happen over the 25-year term of the proposed action. NMFS therefore considers the entire area and depth of each dredging prism to be within the action area for this consultation. The USACE proposes to conduct dredging using either mechanical dredges (clamshell or backhoe) or hydraulic dredges (hopper or pipeline), depending on equipment availability and cost. The equipment used at each site will therefore vary from year to year. Locations for in-water disposal also will vary, depending on the depth of the river bottom each year (i.e., disposal sites will be at least 20-feet deep). The in-water work window (IWWW) at each site is 1 August to 15 December. The estimated number of days the USACE will dredge at each site is also shown in Table 2.

The USACE conducts maintenance dredging and in-water placement of dredged sediments to maintain these authorized navigation channels under Sections 102 and 103 of the Marine Protection Reserve and Sanctuaries Act (MPRSA) of 1972, Sections 401 and 404 of the Clean Water Act (CWA) of 1977, and in accordance with Regulations 33 CFR Parts 335 through 338 ("Operation and Maintenance of Army Corps of Engineers Civil Works Projects Involving Discharge of Dredged or Fill Material into Waters of the U.S. or Ocean Waters" and affiliated procedures, etc.). In the BA, the USACE describes the authorizing legislation and history of each project site as:

- Channelization to create the Tongue Point Channel was approved by the Chief of Engineers on June 14, 1989, under the authority of Section 107 of the River and Harbor Act of 1960, as amended. The most recent dredging at Tongue Point Channel was for initial construction in 1989.
- Channelization to create the Elochoman Slough was authorized by the River and Harbor Act of 26 August 26, 1937. The Elochoman Slough FNC was initially constructed in 1939 and was maintained by the Corps in 1964 and 1989. The channel was most recently dredged by Wahkiakum Port District No. 1 in 2019.
- Channelization to create the Lake River FNC was authorized by the Rivers and Harbors Act of July 3, 1930. Lake River FNC was initially constructed in 1932 and most recently maintained by the Corps in 1980.
- Channelization to create the Oregon Slough (20-foot deep channel) was authorized by the Rivers and Harbors Act of 25 July 1912. This FNC was most recently maintained by the Corps in 1963.[2]

[2] There are multiple authorized Federal Navigation Channel segments within Oregon Slough. The proposed dredge prism in the BA for this project is the 20-foot deep channel from Oregon Slough RM 1.5 to RM 3.8 (USACE 2021).

Table 2. Proposed dredging activities, frequency, and duration at each of the four side channels (USACE 2021).

Project	River Mile	Authorized Dimensions[a]	Amount of Material to be Dredged[b]	Dredge Frequency	Duration[c]
Tongue Point	18.5	34 feet deep 350 feet wide 1.6 miles long Approx. 60 acres	Initial deferred maint. max of 800,000 CY, then future annual maint. need decreasing to 119,000 CY if maintained regularly[d] Up to 75 acres per dredging event	Annually, as needed	Estimated 105 to 137 days
Elochoman Slough	38	10 feet deep 100 feet wide ~2,200 feet long Approx. 5 acres	7,000 to max of 25,000 CY each event Up to 5 acres per dredging event	Average of 1 year out of each 5, but no more than once every 3 years and not to exceed 5 times.	Estimated 3 to 14 days
Lake River	87.5	6 feet deep 100 feet wide 3 miles long Approx. 5 acres	5,000 to max of 34,000 CY each event Up to 5 acres per dredging event	Average of 1 year out of each 5, but no more than once every 3 years and not to exceed 5 times.	Estimated 4 to 15 days
Oregon Slough	104 (south side of Hayden Island)	20 feet deep 200 feet wide 2.3 miles long Approx. 35 acres	Initial deferred maint. max of 600,000 CY, then maintain as needed Up to 50 acres per dredging event	Average of 1 year out of each 5, but not to exceed 5 times.	Estimated 80 to 137 days

[a] All channels may have an additional 2 feet deep and 100 feet outside of the authorized dimensions of advanced maintenance.

[b] Amounts shown include the volumes needed for advanced maintenance and account for dredging inaccuracies. These are the USACE's best estimates based on existing conditions. Higher end of range represents initial dredging of a larger volume, resulting from deferred maintenance; lower end of range for subsequent dredging activities over the 25-year term of the proposed action.

[c] The USACE estimated the number of days required to dredge at each site assuming that a clamshell dredge would be used. This is a conservative assumption because the clamshell removes the smallest amount of material per day (typically 2,000 to 4,000 CY per day).

[d] For Tongue Point, the USACE refers to future annual volumes to be dredged "if maintained regularly" because funding to perform maintenance dredging comes from Congressional appropriations, which vary from year to year (USACE 2021).

Based on information that NMFS provided during consultation, which described uncertainty about benthic prey recolonization rates, the USACE proposes to dredge Elochoman Slough and Lake River no more frequently than once every 3 years. The channel at Tongue Point could need to be dredged annually because it is vulnerable to “side-slope adjustment” (the authorized depth is deeper than the surrounding area, so that sediment slumps into the navigation channel). Under the proposed action, the USACE could dredge the channel in Oregon Slough as frequently as 2 years in a row, but no more than five times over the term of the proposed action.

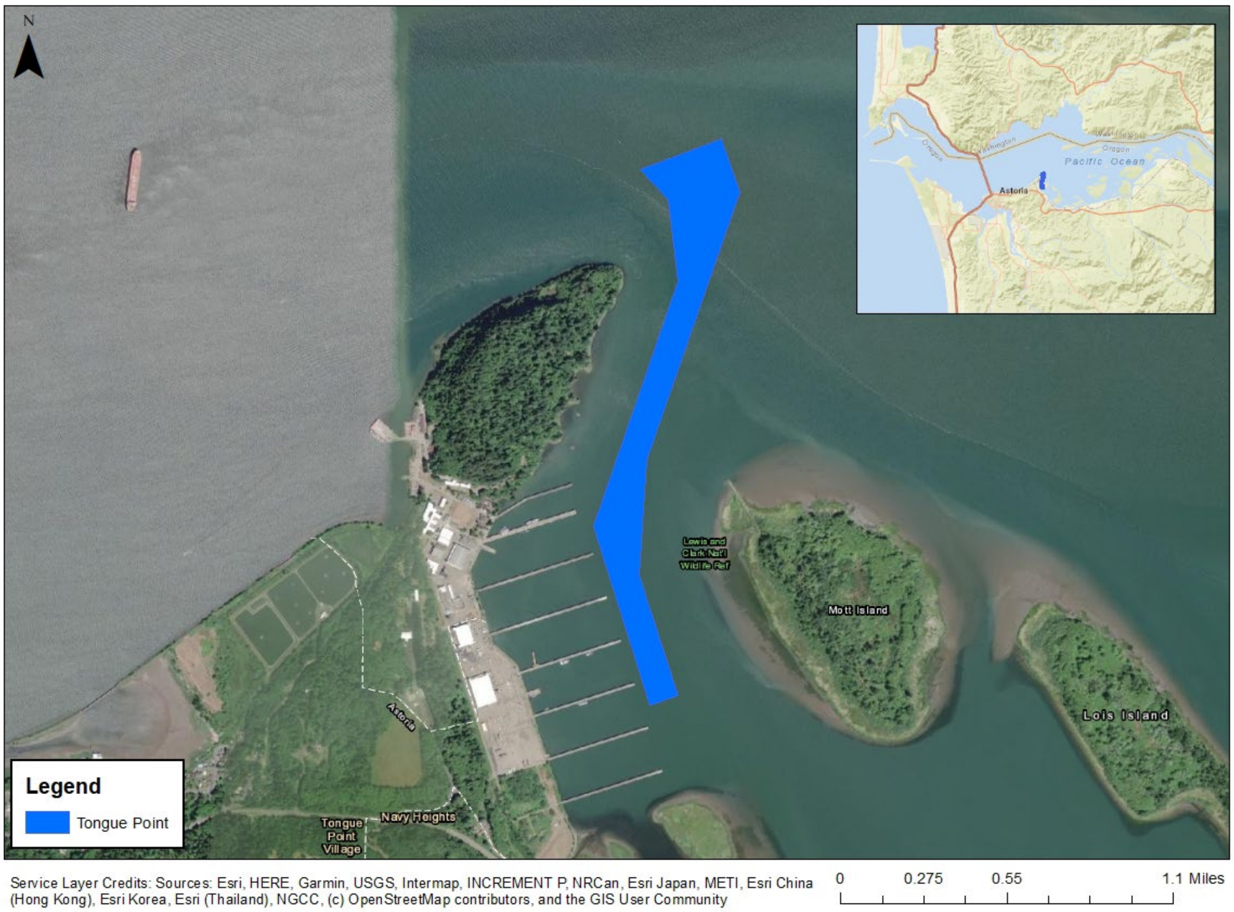

Figure 1. Location of the area to be dredged at Tongue Point, Oregon.

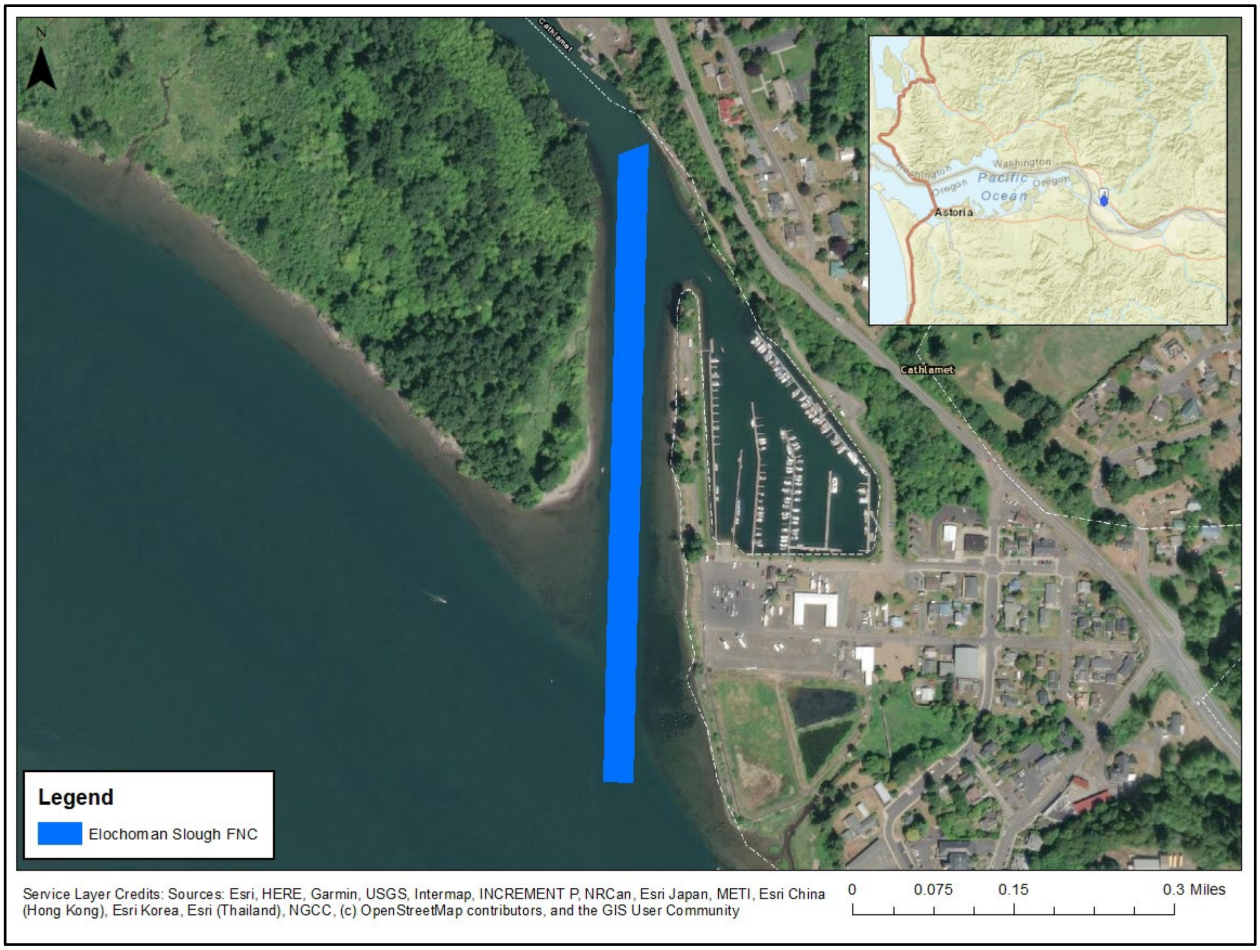

Figure 2. Location of the area to be dredged at Elochoman Slough, Washington.

Figure 3. Location of the area to be dredged at Lake River, Washington.

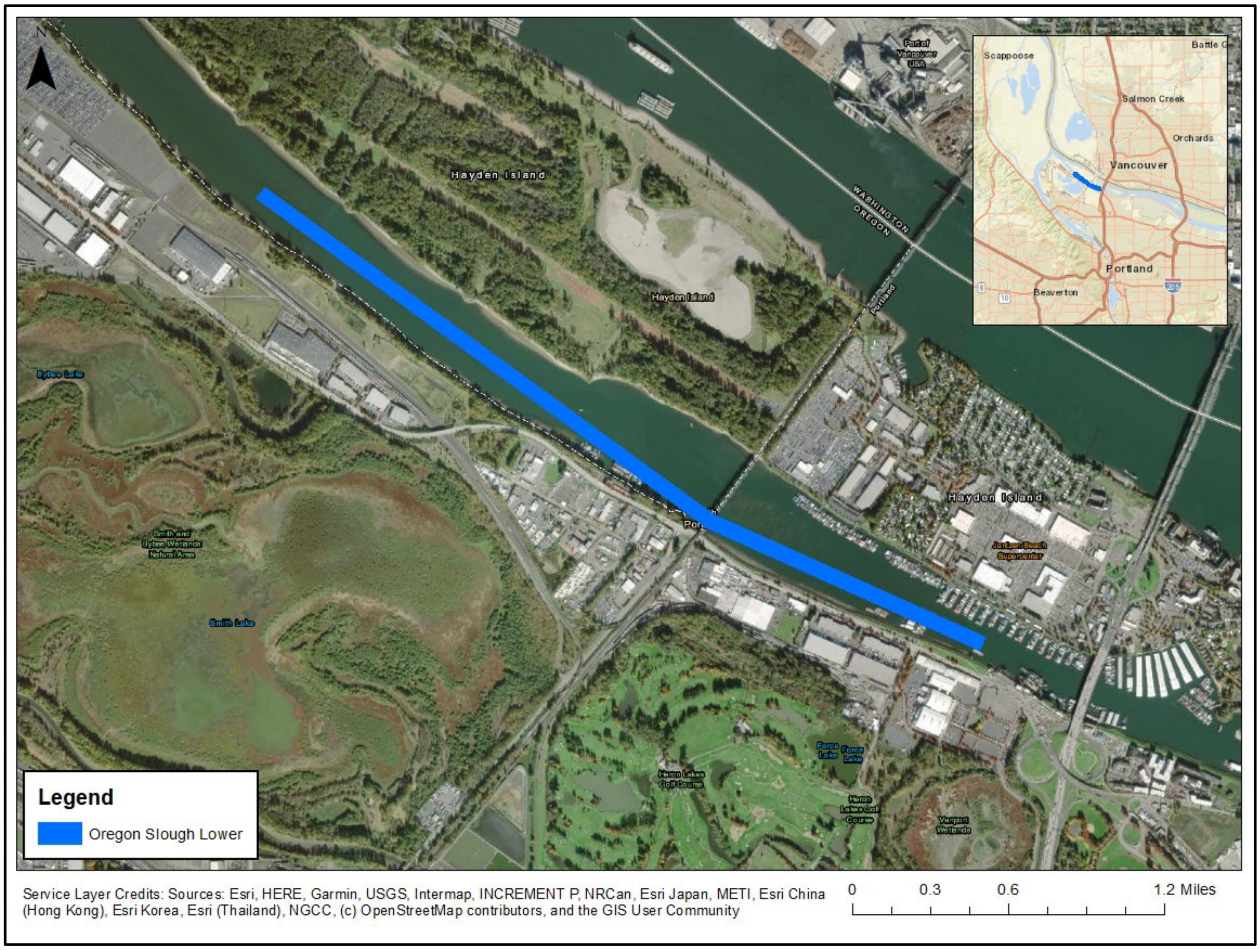

Figure 4. Location of the area to be dredged at Oregon Slough, Oregon.

Two of 93 Dredged Material Management Units (DMMUs) at Tongue Point contained concentrations of diethyl phthalate that exceeded the 200 µg/kg screening level for unconfined aquatic placement. The USACE has further evaluated these sediments using bioassays, but results were not available when the USACE prepared the BA. If the interagency Portland Sediment Evaluation Team (PSET) concludes that, based on the bioassay results, these sediments are not suitable for unconfined aquatic placement (i.e., per the Sediment Evaluation Framework), the USACE will evaluate upland disposal options. The USACE will continue to sample and evaluate material in each side channel periodically over the term of the proposed action and will place dredged material in water only if the PSET concludes that it is suitable for unconfined aquatic placement. Sediments that are determined not to be suitable for unconfined in-water disposal will be placed at upland sites.

Suitable dredged materials from these four side channels will be released in the flow lane between RM 3 and 145, in water deeper than 20 feet. Locations for in-water disposal vary, depending on the depth of the river bottom each year. As deeper areas in the river are filled with dredged material over time, new deep areas are formed elsewhere through natural river processes.

The USACE also proposes the following conservation measures and best management practices, intended to minimize adverse effects on water quality and ESA-listed species and their habitat (Table 3).

Table 3. Proposed **measures** to avoid and minimize effects on ESA-listed species and critical habitat.

Measure	Purpose	Duration and Management Determination
Hopper dredging – dragheads will be buried in the substrate and will not exceed an elevation of 3 feet off the bottom for when cleaning the hopper or reverse purging dragheads.	Minimize or eliminate entrainment of juvenile salmon during normal dredging operations.	Continuous during dredging operations. Maintain until new information becomes available that would warrant change.
Pipeline dredging – cutterheads will be buried in the substrate and will not exceed an elevation of 3 feet off the bottom when cleaning or reverse purging.	Minimize or eliminate entrainment of juvenile salmon during normal dredging operations.	Continuous during dredging operations. Maintain until new information becomes available that would warrant change.
All dredging – in shallow-water areas (less than 20 feet) outside of the Columbia River mainstem should occur only during the recommended ESA in-water work periods for the Columbia River listed in the 2012 BiOp.	The top 20 feet of the water column is considered salmon migratory habitat. Dredging or disposal in these areas could adversely impact salmonids, delay migration, or reduce or eliminate food sources.	Continuous during dredging operations. Maintain until new information becomes available that would warrant change.
All dredging – floating containment and absorbent booms kept on site.	Contain toxic substances in case of accidental spill.	Continuous during dredging operations. Maintain until new information becomes available that would warrant change.

Measure	Purpose	Duration and Management Determination
All dredging – the dredge operator shall not release any trash, garbage, oil, grease, chemicals, or other contaminants into the waterway.	Protect water resources.	Life of contract or action. If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. Contaminated ground shall be excavated and removed and the area restored as directed. Any in-water releases shall be immediately reported to appropriate agencies as detailed in contract specifications.
All dredging – the dredge operator, where possible, will use, or propose for use, materials that may be considered environmentally friendly in that waste from such materials is not regulated as a hazardous waste or is not considered harmful to the environment. If hazardous wastes are generated, disposal shall be done in accordance with 40 CFR 260-272 and 49 CFR 100-177.	Accepted disposal of hazardous wastes.	Life of contract or action. If material is released, it shall be immediately removed and the area restored to a condition approximating the adjacent undisturbed area. Contaminated ground shall be excavated and removed and the area restored as directed. Any in-water releases shall be immediately reported to appropriate agencies as detailed in contract specifications.
All dredging – monitor turbidity levels during dredging in accordance with the NMFS 2012 BiOp or state water quality certification requirements (if more protective).[a]	Limits the time over which turbidity levels that could be harmful to aquatic life can persist in the water column.	Dredging must stop if exceedance over background level occurs at the second monitoring interval; dredging may continue once turbidity levels return to background level.[a]
All dredging – monitor dissolved oxygen levels during dredging in accordance with the current water quality certifications and the NMFS 2012 BiOp to ensure that dissolved oxygen levels do not drop below acceptable levels.[b]	Prevents dissolved oxygen levels from dropping to levels that are harmful to aquatic life.	At least daily. Dredging may not occur if dissolved oxygen is less than 6.5 milligrams per liter. More frequent monitoring if dissolved oxygen is below 8 milligrams per liter.

[a] This measure refers to the turbidity monitoring and responsive actions in Term and Conditions 1.d.iii. and 1.d.iv., including Table 49, in NMFS (2012).

[b] This measure refers to the dissolved oxygen monitoring and responsive actions in Term and Condition 1.e.i through 1.e.vii in NMFS (2012).

We considered whether or not the proposed action would cause any other activities and determined that associated activities are maintenance of current levels of commercial and recreational boating access.

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).

The USACE proposes to dredge four distinct side channels in the lower Columbia River as described in Section 1.3 (Proposed Federal Action). In three cases (Tongue Point, Elochoman Slough, and Lake River), the dredge prism includes an area within the side channel and a connection to the mainstem Federal Navigation Channel (Figures 1-4), but dredging the portions of the fourth channel, Oregon Slough, that connect to the mainstem is not part of this consultation. All dredged material that meets sediment quality criteria will eventually be released in the flow lane between RM 3.0 and RM 145. The locations for in-water disposal will vary, depending on the depth of the river bottom each year, but will be more than 20-feet deep in all cases. The action area therefore includes the four dredge prisms and the mainstem river downstream of RM 145. The mainstem will be affected by increased turbidity for up to 900 feet downstream of each side channel during dredging as well as during flow lane disposal of the excavated sediments. Assuming tidal influence, elevated suspended sediments/turbidity will also extend up to 900 feet upstream of excavated areas within each side channel, during dredging.

All four side channels include critical habitat for salmonids and eulachon. Critical habitat for green sturgeon extends from the mouth of the river through RM 46 (74 FR 52300, October 9, 2009). The action area also includes areas designated as EFH for two Pacific Coast salmon species: Chinook salmon and coho salmon (PFMC 2014) and for groundfish (PFMC 2020). For both salmon and groundfish, the habitat area of particular concern (HAPC) within the action area is "estuaries."

2. ENDANGERED SPECIES ACT: BIOLOGICAL 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 provide 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 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.

The USACE determined the proposed action is not likely to adversely affect southern DPS green sturgeon or southern DPS eulachon or their critical habitat. We find that these species and their critical habitats are likely to be adversely affected by water quality reductions, perturbations to prey, and risk of entrainment, and therefore include them in our formal analysis.

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably 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 designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term 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 a 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' "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 function of the PBFs that are essential for the conservation of the species.

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 et al. 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% 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). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007). 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). 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).

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).

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). 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).

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.

2.2.1 Status of 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). Table 4, below, summarizes the general status of critical habitat, range-wide, for each species considered in this analysis.

Physical and Biological Features of Salmon and Steelhead Critical Habitat

The NMFS designated critical habitat for three different groups of salmonids that occupy the lower Columbia River on three different dates. For each designation, NMFS used slightly different descriptions of the physical and biological features (PBFs) of critical habitat. In addition, NMFS identified the essential elements of the PBFs using slightly different terminology. This section presents each of the approaches to terminology used for each of the subsequent designations and attributes those to the specific salmonids covered by each designation. For convenience, in the remainder of the document we will refer to these attributes as PBFs, even though the original designations used different terminologies. Many of the PBFs and their essential elements actually overlap across designations.

The NMFS designated critical habitat for several Snake River salmonids on October 25, 1999 (64 FR 57399): the SR sockeye and SR spring/summer and fall Chinook salmon ESUs. The PBFs (which we originally termed "essential features") of critical habitat for Snake River salmon are (1) spawning and juvenile rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; and (4) adult migration corridors. The essential elements of the spawning and rearing PBFs are: 1) Spawning gravel; (2) water quality; (3) water quantity; (4) water temperature; (5) food; (6) riparian vegetation; and (7) access. The designation also breaks down the migration corridor for juvenile and adult salmonids as follows: Essential features of the juvenile migration corridors include adequate: (1) Substrate (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions. The adult migration corridors are the same areas included in juvenile migration corridors. Essential features would include those in the juvenile migration corridors, excluding adequate food.

Subsequently, NMFS designated critical habitat for 10 more ESUs and DPSs of Columbia River basin salmon and steelhead, including SRB steelhead, on September 2, 2005 (70 FR 52630), and for lower Columbia River coho salmon on February 24, 2016 (81 FR 9252) (Table 2). The PBFs are referred to as Primary Constituent Elements (PCE) in 70 FR 52630 and in 81 FR 9252, and those terms may be used interchangeably in this document. Specific PBFs, and essential features for salmonids designated in 2005 and in 2016 include:

- Freshwater spawning sites with water quantity and quality conditions and substrate that support spawning, incubation, and larval development;
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, water quality and forage that support juvenile development, and natural cover such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
- Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that support juvenile and adult mobility and survival;
- Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;
- Nearshore marine areas[3] free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and
- Offshore marine areas[4] with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

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.

[3] NMFS designated nearshore marine areas as critical habitat for Columbia basin salmon and steelhead only from the mouth of the river to an imaginary line connecting the outer extents of the north and south jetties.
[4] NMFS did not designate any offshore marine areas as critical habitat for Columbia basin salmon and steelhead.

Physical and Biological Features of Green Sturgeon Critical Habitat

Designated critical habitat for southern DPS green sturgeon includes the lower Columbia River estuary from the river mouth to RM 46 (October 9, 2009; 74 FR 52300), which supports aggregations of southern DPS green sturgeon during summer. Specific PBFs, and the essential features associated with the PBFs for Green sturgeon designated in 2009 include:

- Freshwater riverine systems which provide food resources, and water quality including depth and flow for embryo, larval and juvenile growth and development. Adult spawning requires appropriate substrate and sediment quality, in addition to migratory corridors free of obstruction.
- Estuarine areas which provide food resources, migratory corridors, and appropriate water and sediment quality, flow and depth to support growth of juvenile, sub-adult, and sexually mature green sturgeon.
- Coastal marine areas with adequate food resources are necessary for sub-adult and sexually mature green sturgeon growth. These areas also provide migratory corridors with appropriate water quality to spawning streams.

Physical and Biological Features of Eulachon Critical Habitat

The NMFS designated critical habitat for the southern DPS of eulachon on October 11, 2011 (76 FR 65324). Critical habitat includes portions of 16 rivers and streams in California, Oregon, and Washington. We designated all of these areas as migration and spawning habitat for this species. Specific PBFs, and the essential features associated with the PBFs for eulachon designated in 2011 include:

- Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.
- Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. 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.
- Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter 2000, WDFW and ODFW 2001), unidentified malacostracans (Sturdevant 1999), cumaceans (Smith and Saalfeld 1955), mysids, barnacle larvae, and worm larvae (WDFW and ODFW 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

Table 4. Critical habitat designation date, Federal Register citation, and status summary for critical habitat considered in this opinion.

Species	Designation Date and FR 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 FR 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 2015a). 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 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 FR 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 74 FR 52300. 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 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.

2.2.2 Status of the Species

Table 5, below provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. 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), and VSP (Viable Salmonid Population).

Table 5. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each 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 • Contaminant
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 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	ODFW and 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 Chinook salmon	Threatened 6/28/05	NMFS 2017b	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 2015a	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	ODFW and 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 2009	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 2018a	NMFS 2015b	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 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

2.2.2.1 Information on the Status of Salmon and Steelhead since the 2016 Status Review

The status information presented above is from the 2015 status review. NMFS is developing a new 5-year status review for listed salmonids, green sturgeon, and eulachon. In the biological report for the previous status review, NWFSC (2015) considered population level estimates of spawning adults through about 2013. We included revised 5-year geometric means of abundance (through 2018 or 2019) for listed salmon and steelhead in the 2020 Columbia River System biological opinion (NMFS 2020) and summarize those findings in the following paragraphs, and have included the most current information here. Similar information was not available for the southern DPS of green sturgeon or the southern DPS of eulachon.

Lower Columbia River Chinook Salmon
The best available scientific and commercial data on population-level abundance indicated a mix of recent increases, decreases, and relatively static numbers of natural-origin and total spawners in 2014 to 2018 compared to the 2009 to 2013 period (Table 2.10-2 in NMFS 2020). The direction of the percent change between 5-year geometric means was even mixed within run types. For fall-run Chinook salmon, the percent change increased for the Kalama River; Lower Cowlitz River; Washougal River; Grays and Chinook Rivers; and Lower Gorge Tributaries populations and decreased for the Coweeman River; Upper Cowlitz River; White Salmon River; Clatskanie River; and Mill, Abernathy, and Germany Creek populations.

Observations of coastal ocean conditions since 2016 indicated that recent out-migrant year classes experienced below-average ocean survival during a marine heatwave and its lingering effects (Werner et al. 2017). Some of the negative effects on juvenile salmonids had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 50-m surface layer) had not returned to normal (Harvey et al. 2019). However, the degree to which abundance has been driven by below-average ocean survival or by a variety of environmental conditions and management actions in freshwater, appeared to have varied between populations of LCR Chinook salmon.

Upper Columbia River Spring-run Chinook Salmon
The best available scientific and commercial data on the adult abundance of UCR spring-run Chinook salmon indicated a substantial downward trend in the abundance of natural-origin spawners at the ESU level from 2015 to 2019 (Figure 2.6-2 in NMFS 2020). This downturn was thought to be driven primarily by marine environmental conditions and a decline in ocean productivity. Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.

Population-level abundance estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 also showed recent and substantial downward trends in abundance when compared to the 2009 to 2013 period (Table 2.6-3 in NMFS 2020). All populations remained considerably below the minimum abundance thresholds established by the ICTRT and included substantial numbers of hatchery-origin adults.

Snake River Spring/summer Chinook Salmon
The best available scientific and commercial data on the adult abundance of SR spring/summer Chinook salmon as of 2020 indicated a substantial downward trend in the abundance of natural-origin spawners at the ESU level from 2014 to 2019 (Figure 2.2-3 in NMFS 2020). The past 3-year period, 2017 to 2019, showed the lowest returns since 1999. This recent downturn was thought to be driven by marine environmental conditions and a decline in ocean productivity. Increased abundance of sea lions in the lower Columbia River also could have been a contributing factor.

Population-level estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 (Table 2.2-4 in NMFS 2020) also showed recent and substantial downward trends compared to the 2009 to 2013 period for most of the MPGs and populations (exceptions were the Lemhi River, Camas Creek, and Upper Grande Ronde Mainstem). All populations except Chamberlain Creek remained considerably below the minimum abundance thresholds established by the ICTRT. For many populations, the total spawner counts included substantial numbers of hatchery-origin adults. Exceptions were the entirety of the Middle Fork MPG and several populations in the Upper Salmon MPG, where no hatchery fish are included in the spawner counts.

Upper Willamette River Chinook Salmon
The best available scientific and commercial data for UWR Chinook salmon as of 2020 were counts from the Willamette Falls adult fishway. The 2015 run was relatively large, with 51,046 total adults (9,954 natural origin), but a more recent 5-year geometric mean (2015 to 2019) indicated a decline in both natural-origin and total numbers of adults compared to the previous 5-year period (2010 to 2014; Table 2.13-1 in NMFS 2020). This recent downturn was thought to be driven by marine environmental conditions and a decline in ocean productivity. Increased abundance of sea lions in the lower Columbia River also could have been a contributing factor.

Snake River Fall Chinook Salmon
The best available scientific and commercial data for SR fall Chinook salmon indicated a substantial downward trend in the abundance of natural-origin spawners at the ESU level from 2013 to 2019 (Figure 2.5-2 in NMFS 2020). This downturn was thought to be driven by marine environmental conditions and a decline in ocean productivity. Even with this decline, overall abundance remained higher than before 2005. This ESU appears to have been less negatively affected by ocean conditions than SR spring/summer Chinook salmon.

Columbia River Chum Salmon
The best available scientific and commercial data for CR chum salmon indicated increasing trends in the abundance of both natural-origin and total spawners when compared to the 2009 to 2013 period (Table 2.9-2 in NMFS 2020). The exception was the Upper Gorge Tributaries population, which decreased in abundance. The relationship between ocean conditions and chum salmon survival is an area of active investigation. A preliminary model suggested increased adult returns in response to the same environmental indicators that predicted higher Chinook and coho salmon returns, but it failed to predict the substantial adult returns in 2016 and significantly under-predicted returns in 2017 and 2018 (Hillson 2020, Homel 2020). The above average ocean survival of chum salmon in 2016 through 2018 may have been due to their unique consumption

of the types of gelatinous organisms (jellies, salps, larvaceans) that were abundant during those warm ocean conditions (Brodeur et al. 2019, Morgan et al. 2019).

Lower Columbia River Coho Salmon

The best available scientific and commercial data for LCR coho salmon were at the population level. These indicated a mix of recent increases, decreases, and relatively static numbers of natural-origin and total spawners in 2014 to 2018 compared to the 2009 to 2013 period (see (Table 2.12-2 in NMFS 2020). These findings indicated that the degree to which abundance had been driven by below average ocean survival varied between populations, as described for LCR Chinook salmon.

Snake River Sockeye Salmon

The best available scientific and commercial data for SR sockeye salmon as of 2020 indicated a substantial downward trend in the returns of hatchery-origin and natural-origin adults to the Sawtooth Valley. The 5-year geometric mean of total spawner counts declined 6 percent in 2014 to 2018 when compared to 2009 to 2013 (Tables 2.4-2 and 2.4-3 in NMFS 2020). The recent downturn was thought to be driven by marine environmental conditions and a decline in ocean productivity. However, adult returns to the Sawtooth Valley were also significantly affected by earlier than average warm water temperatures in the mainstem in 2015. And hatchery operations faced significant water chemistry issues in 2015 to 2017, which resulted in very poor survival of outplanted juveniles as they made their way through the Columbia River hydrosystem. Those hatchery practices were modified significantly, and indications were positive that water chemistry is no longer a significant source of mortality during outmigration through the hydrosystem.

Upper Columbia River Steelhead

The best available scientific and commercial data for UCR steelhead indicated a substantial downward trend in the number of natural-origin spawners at the DPS level from 2014 to 2019 (see Figure 2.7-2 in NMFS 2020). This recent downward trend is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity. Increased abundance of sea lions in the lower Columbia River also could have been a contributing factor.

Population level estimates of natural-origin and total (natural- and hatchery-origin) spawners during 2014 through 2018 also showed substantial downward trends in abundance for most of the populations (the percent change was negative, but of a smaller magnitude for the Methow population) when compared to the previous 5-yr period (Table 2.7-3 in NMFS 2020). All populations remained considerably below the minimum abundance thresholds established by the ICTRT.

Lower Columbia River Steelhead

The best available scientific and commercial data for LCR steelhead as of 2020 indicated a mix, at the population level, of recent increases, decreases, and relatively static numbers of natural-origin and total spawners in 2014 to 2018 compared to 2009 to 2013 (Table 2.11-2 in NMFS 2020). However, in all cases where available, abundance estimates for 2019 were lower than the most recent 5year geometric means indicating a common driver such as poor ocean conditions.

Upper Willamette River Steelhead
The best available scientific and commercial data for UWR steelhead were from the Willamette Falls adult fishway. Fishway counts had declined dramatically since the last status review, with 2017 and 2018 counts reaching only 15 to 30 percent of the 5-year geometric mean for the years 2010 through 2014 (Table 2.14-1 in NMFS 2020). It is likely that any recent downturn was linked to poor ocean conditions, as described for other steelhead species.

Middle Columbia River Steelhead
The best available scientific and commercial data for MCR steelhead indicated a substantial downward trend in the abundance of natural-origin spawners at the DPS level from 2014 to 2019 (Figure 2.8-2 in NMFS 2020). This recent downturn was thought to be driven by marine environmental conditions and a decline in ocean productivity. Increased abundance of sea lions in the lower Columbia River also could have been a contributing factor.

Population level estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 or 2019 also showed recent and substantial downward trends for most MPGs and populations (exceptions were the Klickitat and Yakima River populations) when compared to the 2009 to 2013 period (Table 2.8-4 in NMFS 2020). In many cases, the most recent 5-year geometric mean in natural-origin abundance was considerably below the minimum abundance thresholds established by the ICTRT. A relatively limited number of hatchery fish was present on the spawning grounds within this DPS.

Snake River Basin Steelhead
The best available scientific and commercial data for SRB steelhead indicated a substantial downward trend in the number of natural-origin spawners at the DPS-level from 2014 to 2019 (Figure 2.3-2 in NMFS 2020). The number of natural-origin spawners in the Upper Grande Ronde Mainstem population appeared to have been at or above the minimum abundance threshold established by the ICTRT, while the Tucannon River and Asotin Creek populations remained below their respective thresholds (Table 2.3-4 in NMFS 2020). At the MPG level, SRB steelhead generally increased in abundance after the 1990s, but experienced reductions during the more recent period when ocean conditions were poor.

2.2.2.2 Summary – Status of the Listed Species

Each species of salmon and steelhead considered in this opinion is at risk of becoming endangered in the foreseeable future, with the exception of two species (UCR spring Chinook salmon, and SR sockeye salmon), which are currently endangered. Each species is ESA-listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic (and life history) diversity. Many of the component populations of these ESUs and DPSs are also at low levels of abundance or productivity; in many cases, decreases in the last few years are associated with poor ocean conditions. Several species have lost some of their historical population structure due to human activities, and the populations that remain in the available habitat face multiple limiting factors. Individuals from all of the ESA-listed component populations must move through or use parts of the action area at some point during their life history. Being exposed to poor baseline conditions in the action area (see Section 2.3, below) may make individual fish more vulnerable to the effects of the action.

The abundance of the southern DPS of green sturgeon is now estimated at 2,106 spawning adults, but no data are available to establish trends in population growth or decline. The greatest extinction risk for the DPS is that it consists of a single known population that spawns in a limited portion of the Sacramento River, which has been degraded by land use activities and water diversions.

The abundance of the southern DPS of eulachon is at very low levels throughout its range, including the population segment in the lower Columbia River. There was an abrupt decline in the numbers of eulachon returning to the Columbia River in the early 1990s. These improved briefly in the early 2000s, and then returned to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013 to 2015 return years, recent poor ocean conditions, and the concern that these conditions will persist into the future, suggest that populations may continue to decline.

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).

2.3.1. Habitat Conditions in the Action Area

The action area encompasses the four side channels to be dredged, and disposal locations in the flow lane. For this reason, the action area is includes the four dredge prisms and the mainstem river downstream of RM 145, which will be affected by increased turbidity downstream of each side channel during dredging as well as flow lane disposal of the excavated sediments. We consider the entire action area to be estuarine habitat because it is affected by the tides, although the upstream extent of salinity intrusion is approximately RM 34 (Bottom et al. 2005).

The Columbia River estuary provides important migratory and rearing habitat for salmon and steelhead populations, as well as two ESA-listed non-salmonids that are also anadromous, green sturgeon and Pacific eulachon. Since the late 1800s, 68 to 74 percent of the vegetated tidal wetlands of the estuary have been lost to diking, filling, and bank hardening, combined with hydrosystem flow regulation and other modifications (Kukulka and Jay 2003, Bottom et al. 2005, Marcoe and Pilson 2017, Brophy et al. 2019). Disconnection of tidal wetlands and floodplains has eliminated much of the historical rearing habitat for subyearling Chinook and chum salmon and reduced the production of wetland macrodetritus that supports salmonid food webs (Simenstad et al. 1990, Maier and Simenstad 2009), both in shallow water and for larger juveniles migrating in the mainstem (PNNL and NMFS 2020).

Restoration actions in the estuary have improved access and connectivity to some floodplain habitat. From 2007 through 2019, restoration sponsors implemented 64 projects, including dike and levee breaching or lowering, tide-gate removal, and tide-gate upgrades that reconnected over 6,100 acres of historical tidal floodplain habitat to the mainstem and another 2,000 acres of floodplain lakes (Karnezis 2019, BPA et al. 2020). This represents a more than a 2.5 percent net increase in a connectivity index for habitats that are used extensively by subyearling salmon (Johnson et al. 2018, PNNL and NMFS 2020). Although yearling migrants are less likely to enter and rear in these areas, the large amounts of prey (particularly chironomid insects) exported from restored wetlands to the mainstem are actively consumed by both yearling and subyearling smolts. The resulting growth by these fish likely contributes to survival at ocean entry (PNNL and NMFS 2020). In addition to this extensive reconnection effort, about 2,500 acres of currently functioning floodplain habitat have been acquired for conservation. However, much of the historical floodplain remains sequestered behind levees, and riparian conditions along the mainstem and in secondary and side channels are highly degraded by urban, industrial, and agricultural development.

Habitat quality and the food web in the estuary are also degraded because of past and continuing releases of toxic contaminants (Fresh et al. 2005, LCREP 2007) from both estuarine and upstream sources. Historically, levels of contaminants in the Columbia River were low, except for some metals and naturally occurring substances (Fresh et al. 2005). Today, the levels in the estuary are much higher, as it receives contaminants from more than 1,000 sources that discharge into a river and numerous sources of runoff (Fuhrer et al. 1996). With Portland and other cities on its banks, the Columbia River below Bonneville Dam is the most urbanized section of the river. Sediments in the river at Portland are contaminated with various toxic compounds, including metals, PAHs, PCBs, chlorinated pesticides, and dioxin (ODEQ 2008).

Contaminants have been detected in aquatic insects, resident fish species, salmonids, river mammals, and osprey, and they are widespread throughout the estuarine food web (Furher et al. 1996, Tetra Tech 1996, LCREP 2007). Additionally, many contaminants are specifically designed to kill insects and plants, reducing the availability of insect prey or modifying the surrounding vegetation and habitats. Changes in vegetative habitat can shift the composition of biological communities; create favorable conditions for invasive, pollution-tolerant plants and animals; and further shift the food web from macrodetrital to microdetrital sources. Overall, more work is needed on contaminant uptake and impacts on salmon of different populations and life-history types.

In addition, the environmental baseline includes the impacts from dredging to maintain the FNC for commercial vessel traffic and shallow water (shoreline, slough, side channel, and wetland) dredging to maintain marinas for government (e.g., Coast Guard), commercial, and recreational vessels. Modification of the Columbia River for commercial navigation began in 1878, when the Corps began deepening the river to 20 feet−within the range of depths preferred by juvenile rearing and migrating salmonids−then deepening it to 30 feet in 1912, and 35 feet in 1935. Since 1964, the FNC is maintained at 40+ feet in depth. Under the proposed action considered in NMFS (2012), the USACE is periodically dredging nine other secondary and side channels: West Channel in Baker Bay, Chinook Channel, Hammond Boat Basin, Skipanon Channel, Skamokawa Creek, Wahkiakum Ferry Channel, Westport Slough, Old Mouth of the Cowlitz

River, and Upstream Entrance to Oregon Slough. All are degraded by periodic sediment removal, degraded water quality, and the construction, maintenance, and use of moorage facilities. As a result of these and other human activities, the lower river does not provide many areas of rearing habitats in an undisturbed state.

The hydrology of the lower Columbia River also is significantly altered from historical conditions, shifting the natural cues that salmonids rely on for spawning and outmigration behavior. Water management in the Columbia River System and other water storage projects have reduced flows below Bonneville Dam during April through July; these reductions range from average of 7 kcfs in March to 171 kcfs in June. Flow management for hydropower has increased flows during the winter months. The seasonal mainstem temperature regime also has been altered—factors include increased temperatures in tributaries throughout the basin due to flow management, water withdrawals, loss of riparian shading, point source discharges from cities and industry, and climate change. These combine with the thermal inertia of the mainstem reservoirs so that temperatures exceed 70°F during August and early September (Figure 5), affecting the later summer-run as well as early fall-run adults. Elevated temperatures have the potential to reduce the survival and productivity of adult salmon via direct lethality, migration delays, depletion of energy stores through heightened respiration, deformation of eggs and decreased viability of gametes, and increased incidence of disease (McCullough et al. 2001).

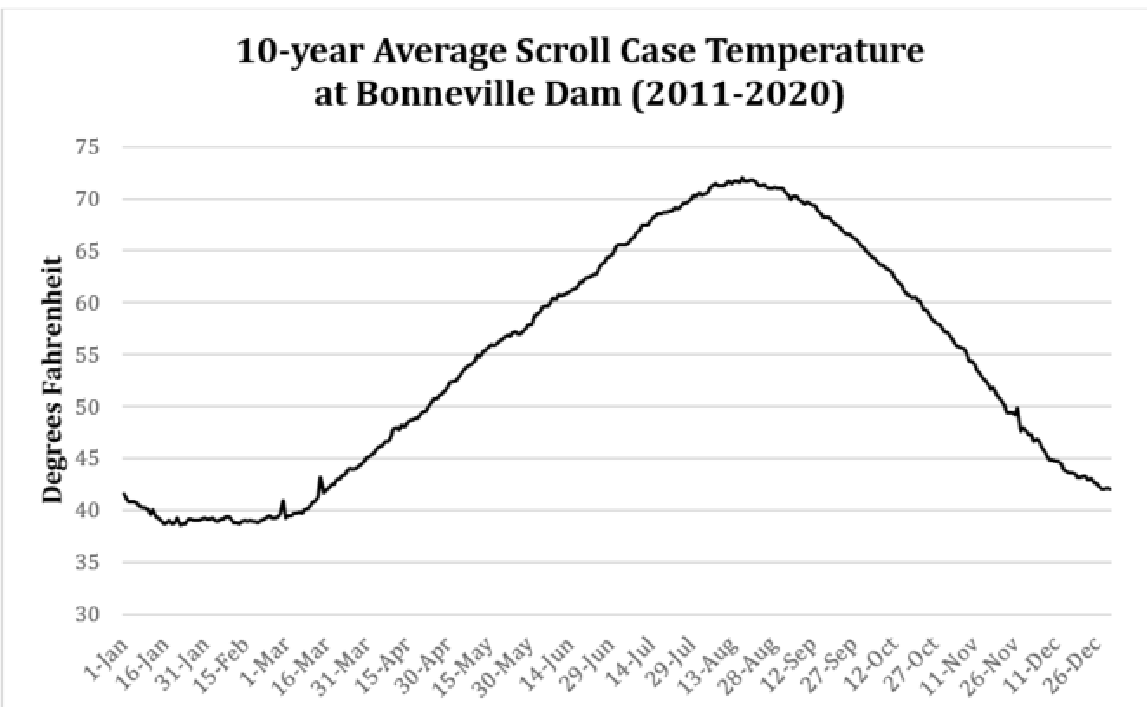

Figure 5. 10-year average temperatures in the scroll case at Bonneville Dam, 2011-2020. Source: Columbia River DART, Columbia Basin Research, University of Washington. River Environment Graphics & Text. Available from http://www.cbr.washington.edu/dart/query/river_graph_text. Accessed April 1, 2021.

The river acquires sediment as it moves downstream. Total sediment load consists of the material that travels in suspension (suspended sediment) and that which rolls and bounces along the bottom (bedload) (Simenstad et al. 1992). Suspended sediment load is mostly silt and clay, particles that can be transported by all but the lowest flows. Major freshets also can transport fine sand, which is otherwise carried downstream as bedload. Because of the exponential relationship between sediment transport and river flow, even a small reduction in peak flow during the freshet can cause a large decrease in sediment transport. Sherwood et al. (1990) calculated an average annual total suspended load for the period 1868 to 1934 (before the construction of the Federal hydrosystem) of 14.9 metric tons (MT) per year. This decreased to an estimated 7.6 MT per year in 1958 to 1981. The percent fine sand decreased from more than 50 percent before 1900 to about 33 percent for 1958 to 1981. Thus, while the model used by Sherwood et al. (1990) reduced the total input of fine sediment to the lower river by about a third between the two time periods, it reduced the input of sand (the dominant size class retained in the estuary) by a factor of three. Most of the change was attributed to flow regulation, due to the reduced intensity of the spring freshet. Although the consequences of reduced sand transport to habitat in the action area are unknown, the magnitude of the decrease indicates that there may have been a substantial effect on habitat-forming processes including those in shoreline rearing areas used by juvenile salmonids, spawning and incubation areas used by eulachon, and foraging areas used by sub-adult and adult green sturgeon.

Juvenile salmonids are vulnerable to predation by birds, fish, and marine mammals, and sea lions also prey on returning adults. A Columbia basin-wide assessment (Roby et al. 2021) of avian predation indicates that the most significant impacts on smolt survival are on steelhead and occur in the Columbia River below Bonneville Dam. Actions to reduce avian predation rates are ongoing, but this factor continues to affect juvenile survival and safe passage and refuge in rearing areas and migration corridors for salmonid ESUs and DPSs. Predation by Caspian terns (*Hydropogne caspia*) on East Sand Island is especially high for juvenile steelhead (more than 10 percent of each cohort of PIT-tagged fish passing Bonneville Dam; Chapter 1 in Roby et al. 2021). Predation on LCR Chinook salmon by double-crested cormorants (*Phalacrocorax auritis*) is also very high—up to 7 percent for the small numbers of birds that now nest on East Sand Island and even higher numbers for the colony that has moved to the Astoria-Megler Bridge (Chapter 4 in Roby et al. 2021). Rearing areas with diverse topography, including shoreline vegetation and overhanging banks, are therefore important for the functioning of rearing areas within the action area.

The native northern pikeminnow (*Ptychocheilus oregonensis*) is a significant predator of juvenile salmonids in the Columbia and Snake Rivers followed by non-native smallmouth bass and walleye (reviewed in Friesen and Ward 1999; ISAB 2011, 2015). Before the start of the sport reward fishery in the Northern Pikeminnow Management Program in 1990, this species was estimated to eat about 8 percent of the 200 million juvenile salmonids that migrated downstream in the Columbia River each year. Williams et al. (2017) compared current estimates of northern pikeminnow predation rates on juvenile salmonids to before the start of the program and estimated a median annual reduction of 30 percent. The lower Columbia River has been the highest producing zone for the pikeminnow sport reward fishery for all but one season since system-wide implementation began in 1991 (Williams et al. 2018, Winther et al. 2019). The Oregon and Washington Departments of Fish and Wildlife, which manage the non-native fish predators smallmouth bass and walleye, have removed size and bag limits for these species in their sport fishing regulations in an effort to reduce predation pressure on juvenile salmonids. Removing more of these individuals, in addition to pikeminnow, reduces predation on juvenile salmonids and the functioning of rearing and migration areas within the action area.

Predation of adult salmonids by pinnipeds has been a concern due to the general increase in sea lion populations along the West Coast and the numbers observed in the tailrace of Bonneville Dam. The Endangered Salmon Predation Prevention Act, signed into law in December, 2018, reduced restrictions on control efforts (by superseding the criteria that sea lions be individually identifiable and having a significant negative impact before lethal removal) and allowed the removal of Steller as well as California sea lions in the Columbia River and its tributaries. A permit issued by NMFS in 2020 allows three states and six tribes to kill as many as 540 California sea lions and 176 Steller sea lions between Portland and McNary Dam. According to the Oregon Department of Fish and Wildlife, the number of California sea lions feeding in the tailrace at Bonneville Dam declined from a high of 104 animals in 2003 to a low of 19 in 2019 (ODFW 2021). This indicates that control efforts are improving the survival of adult salmonids and sub-adult and adult green sturgeon and the functioning of the adult migration corridor in the action area.

The baseline also includes the future effects of Federal actions that have proceeded subsequent to section 7 consultation. During the last five years, NMFS has engaged in several Section 7 consultations on Federal projects adversely affecting ESA-listed fish and their habitats in and near the action area. These include vicinities (Multnomah County, Oregon; Clark County, Washington) adjacent to or within the action area (WCR-2019-11648, WCR-2018-10138, WCR-2017-7450, WCR-2017-6622, WCR-2016-5516), including the effects of actions addressed in programmatic consultations (the SLOPES IV programmatic consultation; NMFS number WCR-2011-05585). In general, those actions caused temporary, construction-related effects (increased noise and turbidity), and longer term effects like increasing overwater coverage. Conditions of the baseline hinder the quality of downstream migration and reduce benthic production of forage items.

All of the actions processed under the SLOPES IV programmatic consultation also include minimization measures to reduce or avoid both short- and long-term effects in the environment. These include requiring grated and translucent materials to allow light penetration, pile caps to prevent piscivorous bird perching, and limits on square footage of new overwater coverage. Actions implemented under SLOPES IV continue to have some effects that can reduce fitness[5] in a small number of individuals, and have contemporaneous minimization measures to reduce the level of habitat degradation at large. Overall effects of these SLOPES IV actions incrementally contribute to the condition of habitat in the action area under the environmental baseline and the effects of existing structures (e.g. increased shading, reduction in prey, increased predation, and possible minor migration delays).

The condition of habitat within the action area described above includes habitat features used by green sturgeon and eulachon (water quality, water quantity, depth, sediment condition, and prey quality and quantity) is described below as the condition of the PBFs of designated critical

[5] For this analysis, we define fitness as the ability to survive to reproductive age, find a mate, and produce offspring.

habitat. Information specific to green sturgeon and eulachon habitat is described below, as the condition of the PBFs of designated critical habitat.

Conditions within the Four Side Channels

In the BA, the USACE provides physical and chemical information on sediment conditions in the four side channels that it proposes to dredge (Table 6). The percent fines was relatively low in Oregon Slough (less than 9.0 percent) and relatively high in Elochoman Slough, the inner part of the Lake River dredge prism, and the inner shoal at Tongue Point.

Table 6. Physical characteristics of sediments in the four side channels considered in this opinion (USACE 2021).

	Tongue Point	Elochoman Slough	Lake River	Oregon Slough
Sampling date	Nov. 2019	Aug. 2015	Nov. 2018	Sept. 2020
% Silt/clay	3.6% at Outer shoal 53.% at Inner shoal	50.0	<41.0	<9.0

Contaminant testing indicated that 2 of 93 Dredged Material Management Units at Tongue Point contained diethyl phthalate at concentrations that exceeded the screening level for unconfined in-water disposal (Section 1.3). These sediments were further tested in bioassays and determined suitable for in-water disposal (USEPA 2021). No exceedances of screening levels were reported for sediments from Elochoman Slough or Lake River; results were not available for sediments from Oregon Slough at the time the BA was completed.

Beyond these physical and chemical parameters, little information is available on the current condition of fish habitat in these side channels. All four are used to access local marinas and therefore are subject to repeated human disturbance in the form of boat traffic. Boating results in discharges of pollutants and the physical disruption of wetland, riparian and benthic communities and ecosystems through the actions of a boat hull, propeller, anchor, or wake (USEPA 1993, Carrasquero 2001, Kahler et al. 2000, Mosisch and Arthington 1998). Sediment resuspension, water pollution, disturbance of fish and wildlife, destruction of aquatic plants, and shoreline erosion are the major effects pathways of concern (Asplund 2000). However, the benthic environment in these side channels has not been dredged for 30 years at Tongue Point, 40 years at Lake River, and almost 60 years in the proposed dredging prism within Oregon Slough. We expect that, in the absence of dredging, these sites have developed robust benthic communities that provide abundant prey for juvenile salmonids, and in the case of Tongue Point, green sturgeon. The channel at Elochoman Slough was dredged by Wahkiakum Port District No. 1 in 2019 (Section 1.3).

Condition of Critical Habitat for Salmonids within the Action Area.

Currently, a lack of habitat opportunity and reduced habitat quality limit the viability of salmon and steelhead in the Columbia River estuary. The amount and accessibility of in-channel and off-channel habitat have been reduced by the conversion of aquatic habitat for agricultural, urban, and industrial uses; hydroregulation and flood control; and channelization. The degraded habitat conditions in the estuary affect the abundance, productivity, spatial structure, and diversity of

ESA-listed salmon and steelhead and have led both the Oregon and Washington Management Unit recovery plans to list to estuarine habitat issues as one of six general categories of threats that limit the viability of LCR Chinook and coho salmon and steelhead and CR chum salmon. Both Management Unit plans cite water quantity and flow timing, impaired sediment and sand routing, altered channel structure, and loss or degradation of peripheral and transitional habitats in the Columbia River estuary as primary limiting factors for juveniles from all three lower river salmon ESUs and the LCR steelhead DPS (NMFS 2013).

The condition of the physical and biological features essential for conservation discussed above and summarized here in Table 7. Across the action area, widespread development and other land use activities have disrupted watershed processes (e.g., erosion and sediment transport, storage and routing of water, plant growth and successional processes, input of nutrients and thermal energy, nutrient cycling in the aquatic food web, etc.), reduced water quality, and diminished habitat quantity, quality, and complexity. Past and current land use or water management activities in subbasins that drain to the lower Columbia River have adversely affected the quality and quantity of riparian conditions, floodplain function, sediment conditions, and water quality and quantity; as a result, the important watershed processes and functions that once created healthy ecosystems for salmon and steelhead production have been weakened. Conditions in the action area have been substantially affected, and improvements may be needed before these areas function at a level that supports recovery.

Table 7. Physical and biological features (PBFs) of designated critical habitat for Columbia River basin salmon and steelhead.

Physical and Biological Feature (PBF)	Components of the PBF	Principal Factors Affecting Condition of the PBF
Freshwater spawning sites	n/a	Does not occur within the action area
Freshwater rearing sites	Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, water quality and forage, and natural cover.	Loss of vegetated and tidal wetland connectivity (diking, filling, bank hardening) have reduced the quantity and quality of freshwater rearing sites in the lower Columbia River estuary and the production and export of prey and organic detritus to the mainstem food web. Toxics accumulations (urban and rural development, forest and agricultural practices) have reduced water quality in freshwater rearing sites. Disruption of benthic prey communities in slough and side channel habitats (dredging, marina development and operations).

Physical and Biological Feature (PBF)	Components of the PBF	Principal Factors Affecting Condition of the PBF
Freshwater migration corridors	Free of obstruction and excessive predation, adequate water quality and quantity, and natural cover.	Alteration of the seasonal flow regime in the lower Columbia River with elevated fall and winter and reduced spring flows (hydrosystem development and operation). Reservoir releases are managed to seasonal flow objectives for juvenile fish survival given the amount of runoff expected in a given year, resulting in a small negative effect on water quantity in average- to high-flow years and a moderate negative effect in lower flow years. Alteration of the seasonal mainstem temperature regime in the lower Columbia River due to thermal inertia associated with the hydrosystem reservoirs. Temperatures are generally cooler in the spring and warmer in late summer and fall than in the predevelopment condition. This has negatively affected the functioning of water quality in the juvenile and adult migration corridors for the latest migrating subyearling smolts and the summer and earliest migrating adult fall-run Chinook salmon and summer-run steelhead populations (Appendix). Water quality in the mainstem migration corridor is not negatively modified for other adult run types (spring-run salmon and winter-run steelhead). Toxics accumulations (urban and rural development, forest and agricultural practices) have reduced water quality in freshwater rearing sites. Increased mortality on juvenile migrants due to avian predation, especially in the vicinity of East Sand Island and the Astoria-Megler Bridge. Increased mortality on adult migrants due to pinniped predation.
Estuarine areas	Free of obstruction and excessive predation with water quality, quantity, and salinity, natural cover, juvenile and adult forage.	Same as freshwater migration corridors.
Nearshore marine areas	Free of obstruction and excessive predation with water quality, quantity, and forage.	Same as freshwater migration corridors and estuarine areas.

Condition of Critical Habitat for Green Sturgeon within the Action Area
NMFS designated critical habitat for southern DPS green sturgeon from the mouth of the Columbia River to RM 46, an estuarine area. The essential features of this PBF are food resources, migratory corridors, appropriate water and sediment quality, and appropriate flow and depth to support the growth of sub-adult and adult (sexually mature) green sturgeon. We summarize the current status of these essential features is as follows:

- Prey species for green sturgeon within bays and estuaries primarily consist of benthic invertebrates and fishes, including crangonid shrimp, burrowing thalassinidean shrimp (particularly the burrowing ghost shrimp), amphipods, isopods, bivalves, annelid worms, crabs, sand lances, and anchovies (Dumbauld et al. 2008, 74 FR 52300). The types of invertebrate and fish prey favored by green sturgeon is likely to be present in the lower 46 miles of the Columbia River, but whether the abundance is adequate for the sub-adult and adult fish that are present during summer is unknown.
- Although water temperature in the lower Columbia River is affected by the existence and operation of the Federal hydrosystem's dams and storage reservoirs, temperatures in the lower 46 miles are also strongly affected by tidal exchange with the ocean. NMFS (2018a) lists the alteration of water temperatures due to climate change as a "very high" threat in coastal bays and estuaries.
- Suitable water and sediment quality requires low levels of contaminants that otherwise may disrupt the growth and survival of the sub-adult and adult life stages (74 FR 52300). Contaminants due to oil and chemical spills are a "high" threat in coastal bays and estuaries (NMFS 2018a).
- Migratory pathways must allow safe and timely passage. Ship strike, including dredge vessels and barges, is a potential source of degraded passage conditions in the Columbia River estuary.
- Sub-adult and adult green sturgeon require a diversity of depths in estuarine areas for shelter, foraging, and migration. This includes shallow depths used for feeding such as the side channel habitats in the Columbia River estuary.
- Sediment quality necessary for normal behavior, growth, and viability of all green sturgeon life stages includes sediments free of elevated levels of contaminants, such as PAHs and pesticides (74 FR 52300). The USACE's pre-dredging sediment analysis for Tongue Point detected diethyl phthalates at concentrations requiring further testing in 2 of the 93 Dredge Material Management Units (Section 1.3). The same testing of sediment samples from the dredge prism in Elochoman Slough indicated that the material was adequate for unconfined, in-water disposal. The remainder of the action area that is within designated critical habitat for green sturgeon is the flow lane of the mainstem Columbia River below RM 46. Sediment quality is likely to vary throughout this reach.

Condition of Critical Habitat for Eulachon within the Action Area
NMFS designated critical habitat for southern DPS eulachon in the lower Columbia River up to Bonneville Dam and in some tidally influenced areas including the lower reaches of the Elochoman River. The environmental baseline for the PBFs for eulachon critical habitat is reflected in the effects on the physical and biological features needed for conservation discussed above (e.g., mainstem flows, water quality, and predation) and summarized in Table 8.

Table 8. Physical and biological features (PBFs) of designated critical habitat for the southern DPS eulachon.

Physical and Biological Feature (PBF)	Components of the PBF	Principal Factors Affecting Condition of the PBF
Freshwater spawning and incubation sites	Water flow, quality, and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles.	Less fine sediment and sand available to replenish habitat along the margins of the river, at least as far downstream as the Willamette River confluence (hydrosystem development and operations). Altered mainstem flow regime, generally increasing winter flows (November through March), when eulachon are present, and reducing peak spring flows (May and June) (water management). Altered mainstem water temperatures (generally increasing minimum winter temperatures, during spawning season, and decreasing spring temperatures) (hydrosystem development and operations; climate change). Alteration of mainstem spawning and incubation habitat by dredging (navigation). Increased levels of toxic contaminants (land use, industrial development). Increased levels of nutrients and fecal bacteria, lower dissolved oxygen in shoreline areas near leaking septic systems (rural residential and urban development). Risk of injury or mortality for adults that pass Bonneville Dam (most likely through the navigation lock) and fallback downstream [Jan-Mar] (hydrosystem development and operations). Increased exposure of eggs and larvae to total dissolved gas for greater than 35 miles downstream of Bonneville Dam for late migrants that are still in the mainstem when spring spill operations begin on April 10 (hydrosystem development and operations).
Freshwater and estuarine migration corridors	Free of obstruction and with water flow, quality, and temperature conditions that support larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted.	Risk of injury or mortality for adults that pass Bonneville Dam (most likely through the navigation lock) and fallback downstream [Jan-Mar] (hydrosystem development and operations). Loss of a large proportion of the estuarine floodplain (agricultural, rural residential, urban, and industrial development). Recent floodplain reconnection projects are expected to support the production of eulachon prey (phytoplankton) in the lower river by improving the flux of organic material and nutrients (habitat restoration).

2.3.1.1 Summary of Habitat Conditions and Designated Critical Habitat in the Action Area

Under the environmental baseline, the fish from the component populations of each salmonid ESU and DPS that move through and use the action area will encounter habitat conditions degraded by a modified flow regime, reduced water quality from substantial chemical pollution, loss of functioning floodplains and secondary channels, and loss of vegetated riparian areas and associated shoreline cover. The significance of this degradation is reflected in the limiting factors described in recovery plans: insufficient access to floodplain and secondary channels, degraded habitat, loss of spawning and rearing space, pollution, and increased predation. We do not know of habitat conditions in the action area that limit the likelihood of survival and recovery for green sturgeon. Habitat conditions for eulachon are affected by hydrosystem operations and dredging and disposal activities that affect the quantity and quality of substrate for egg and larval development.

Likewise, the environmental baseline does not fully support the conservation role of designated critical habitat for the listed species. The PBFs within the action area that are essential for the conservation of salmon and steelhead include freshwater rearing sites, freshwater migration corridors, and estuarine rearing areas. Despite the degraded conditions, conservation value is high because migration is an obligate role for the habitat to maintain adult access to spawning areas, and juveniles to maintain access to the ocean to complete their life history demands. The Action Agencies and other Federal and non-Federal entities have taken actions in the last two decades to improve the functioning of some of these PBFs. Projects that have protected or restored riparian areas and breached or lowered dikes and levees in the estuary have improved the functioning of rearing sites and the juvenile migration corridor. However, habitat conditions as a whole remain highly modified and the factors described above continue to have negative effects on these PBFs. The estuarine PBF of critical habitat for green sturgeon within the action area is negatively affected by ship traffic and sediment contaminants, and the abundances of preferred prey are unknown. Similarly, the loss of sand due to the existence and operation of the hydrosystem and dredging of the navigation channel and potentially, some side channels, has negatively affected the PBF of substrate in freshwater spawning and incubation sites for eulachon.

2.3.2. Species in the Action Area

All 13 species of ESA-listed Columbia basin salmon and steelhead, and all of their component populations, migrate through the action area. Subyearling Chinook salmon from the Lower Columbia River and Upper Willamette River ESUs and Columbia River chum rear along the shoreline for weeks or months and are exposed to impaired habitat conditions within the action area for much of the juvenile life stage. The larger side channels like the ones that the Corps proposes to dredge for this project, are likely to be important to these fish for foraging and resting where there is no adjacent floodplain wetland, or the wetland is not inundated (e.g., during periods of low tides or low mainstem flow; Roegner et al. 2021).

Large yearling Chinook, coho, and sockeye salmon and steelhead from the interior Columbia basin move through the mainstem relatively quickly on their way to the ocean. However, yearling Chinook from lower river genetic stocks use side channels between islands and the

Oregon and Washington shorelines (Johnson et al. 2015, Sather et al. 2016). Juvenile ESA-listed species also have a wide horizontal and vertical distribution in the Columbia River related to size and life stage. Juvenile salmonids occupy the width of the river, from the surface to average depths of 35 feet (Carter et al. 2009). The likely ESUs and DPSs of Columbia basin salmonids that are likely to be present during the 1 August through 15 December IWWW are shown in the Appendix.

Upstream migrating adult salmonids, especially summer-, fall-, and winter-run fish, migrate along the shoreline or in the channel during the period when the USACE proposes to dredge side channels and release the excavated material in the flow lane (Appendix).

Sub-adult and adult southern DPS green sturgeon migrate seasonally along the West Coast, congregating in bays and estuaries, including the lower Columbia River, during the summer and fall. Individual green sturgeon exhibit diel movements, using deeper water during the day and moving to shallower water during the night to feed (Moser and Lindley 2007). Little is known about green sturgeon diet in estuaries or in the coastal ocean. A very limited sample of green sturgeon stomachs in the Columbia River found mostly crangonid shrimp and some thalassinid shrimp (Dumbauld et al. 2008). The presence of these prey species suggests the sampled green sturgeon fed in the saline and brackish water reaches in the lower Columbia River estuary. However, ODFW (2020) reports occasional incidental catches green sturgeon in commercial gillnets above RM 46 during summer and even young-of-year fish in its own gillnet sampling for sturgeon during the fall. Many of these, and four young-of-year fish captured during the state's gillnet sampling for white sturgeon, are from the unlisted northern DPS (Schreier and Stevens 2020).

Eulachon also migrate through the action area, both as adults and larvae. Adult migrations can occur as early as November or as late as June. Peak spawning typically occurs between January and March, but can occur in December. Eggs are fertilized and drift downstream, adhering to sand and small gravels, and hatch in 3 to 8 weeks depending on water temperatures. Larvae are transported downstream and after rearing in the estuary for an unknown amount of time, move to the ocean (NMFS 2017c).

Because all of the ESA-listed species considered in this opinion must migrate through the action area, all are exposed to the degraded baseline conditions. Salmonids that spend months rearing in the action area (subyearling LCR and UWR Chinook and CR chum salmon) are exposed for a significant portion of their life cycle. These conditions may negatively affect the condition of individuals that also will be exposed to the effects of the proposed action, and may influence the nature and degree of their response.

2.4. Effects of the Action

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 action include the effects on habitat that fish will experience and respond to, and effects on the fish themselves. The effects on habitat include: (1) reduced safe passage conditions in migration and rearing areas for salmonids, estuarine areas for green sturgeon, and migration and spawning and incubation areas for eulachon because of entrainment risk, (2) water quality reductions in rearing and migration areas for salmonids contemporaneous with the dredging and disposal activities, but abating within hours post-work, and (3) prey reductions in juvenile salmonid rearing areas and estuarine areas for green sturgeon that persist for uncertain periods of time (weeks to months, and potentially years) post-dredging.

2.4.1 Entrainment

In this analysis, entrainment refers both to the uptake of aquatic organisms by dredge equipment and the transport of organisms by the downward motion of sediments during in-water disposal. Both mechanical and hydraulic dredges commonly entrain slow-moving and sessile benthic epifauna along with the burrowing infauna that are removed with the sediments.

Critical Habitat
Safe passage conditions are a feature of designated critical habitat where the role of the habitat is to serve migration. Here the action area serves a migration role for all 15 ESA-listed species. Entrainment risk is a consequence both from the dredging and the placement of dredge materials. Mechanical dredges can entrain organisms by capturing them in the clamshell or backhoe bucket. Hydraulic dredges can entrain organisms by suction as sediment and water are pumped into the draghead or cutterhead. Both types of dredge reduce safe passage. The release of dredged sediments from the bottom of a barge or placement pipe can also entrain organisms by catching them in currents created as the discharge descends through the water column. A barge releases a substantial amount of sediment into the flow lane at one time, compared to a pipeline that continuously releases smaller amounts of material while the dredge is operating. Thus, the risk of entrainment in the flow lane is higher for material released from a barge than from a pipeline.

The timing of dredge and disposal activities affects the project’s influence on migration values for a given species. If equipment is dredging or depositing dredged materials when fish are migrating to or from the ocean, then safe passage in that habitat will be diminished for that species. And safe passage conditions in the migration corridor may be diminished for one life stage of a species, but not another. Based on the 1 August to 15 December IWWW and the life history timing in the action area for each species (Appendix), we anticipate the safe passage element will be negatively affected each year that dredging occurs over the 25-year duration of the proposed action for the following PBFs:

- LCR Chinook salmon—juvenile and adult migration corridors, rearing areas
- UCR spring-run Chinook salmon—juvenile migration corridor, rearing areas
- UWR Chinook salmon—juvenile migration corridor
- SR spring/summer Chinook salmon—juvenile and adult migration corridors
- SR fall Chinook salmon—juvenile and adult migration corridors

- CR chum salmon—adult migration corridor, rearing areas
- LCR coho salmon—juvenile and adult migration corridors
- SR sockeye salmon—juvenile migration corridor
- MCR steelhead—juvenile migration corridor
- UCR steelhead—juvenile migration corridor
- UWR steelhead—juvenile migration corridor
- SRB steelhead—juvenile migration corridor
- SDPS green sturgeon—sub-adult and adult migration corridors (to over-summering habitat)

Safe passage in the adult migration corridor will also be negatively affected for SDPS eulachon. In addition, the functioning of migratory access to spawning and incubation sites will be disrupted if eulachon would otherwise spawn in one or more of the four side channels during the IWWW (e.g., if the USACE is dredging during early December).

Exposure and Response of Salmonids to Entrainment

In order to be entrained, highly mobile organisms such as adult and yearling salmonids must be directly in the path of a bucket or backhoe or within the suction area for a hydraulic cutter or draghead. This exposure will occur in a small area at any given time, compared with the distribution of fishes across the available habitat. Further, mechanical dredges move slowly during dredging operations, with the barge staying in one location for up to several hours, while the bucket or backhoe is repeatedly deployed within that area. Studies confirm the entrainment of fish and other organisms by hydraulic dredges (Armstrong et al. 1981; Boyd 1976; Dutta and Sookachoff 1975; R2 Resource Consultants 1999). Although there is evidence of fish surviving entrainment (Armstrong et al. 1981), entrainment is often fatal. This is not surprising, especially for larger organisms that are likely to be impacted by the cutterhead and/or pump impellers, before being dumped along with the dredged material into a hopper or onto a disposal area. Hopper dredges operate for prolonged periods, generating continuous fields of suction forces around and under the dragheads while they are pulled along the substrate at relatively high speed as compared to other dredge methods. Entrainment of fish and other mobile organisms by a hopper dredge is believed to occur most often when the dragheads are out of firm contact with the channel bottom (Reine and Clarke 1998). Typical operations require the initial run-up of the pumps before the dragheads contact the bottom, and the pumps are operated with the dragheads raised from the bottom at the end of a run to clear the dragarms. Other situations that may cause the loss of firm contact with the bottom include increases in depth that exceed the draghead's ability to remain flat against the bottom, along with wave action that may periodically pull the draghead away from the bottom. The potential for entrainment also increases with increased dredge size and flow (suction) rates.

Hydraulic pipeline dredges also entrain fish, especially smaller fish that are less able to swim against the powerful currents near the cutterhead, which is often unshrouded. Several studies confirmed entrainment of juvenile salmon by hydraulic pipeline dredging in the Fraser River (Boyd 1976; Dutta and Sookachoff 1975).

We expect that most of the large fish that are in the vicinity of a dredge at the start of operations are likely to swim away to avoid the noise and activity. Therefore, we consider it highly unlikely that any of the adults and very few of the yearling salmonids considered in this opinion would be entrained by the dredges. The risk of entrainment, and injury or death, is higher for the small subyearlings because it is influenced by the swimming stamina and size of the individual fish (Boysen and Hoover 2009). Small, subyearling Chinook and chum salmon from lower river spawning areas (i.e., populations of LCR and UWR Chinook salmon and CR chum salmon) will be present during the IWWW, with some individuals rearing in or moving through each side channel during excavation. We are unable to estimate the numbers of these fish that will be injured or killed through this pathway, but assume that the magnitude of exposure to and the likelihood of entrainment is a function of the expected days of operation and the frequency of dredging, combined with the volume of material to be dredged (Table 2). Therefore, we anticipate that entrainment will reduce the fitness (likelihood of surviving to adulthood, mating, and producing offspring) of some individuals of each of the salmonid species over the 25-year period of dredging activities.

Excavated sediments that are approved for in-water disposal would be released in the flow lane between RM 3 and 145 at a depth below 20 feet.[6] As dredged material is released from the bottom of a barge, it falls through the water column and mixes with the ambient water to create a plume (USACE 2005). When the diluted material hits the bottom, it spreads out until its energy is expended and then slowly settles out under the influences of gravity and local currents. A 6-inch fish could be dragged downward with the plume, but would most likely be displaced laterally, parallel to the bottom, as the plume reached the boundary layer. Disposal from a pipeline dredge would be less forceful, but continuous while the dredge is operating. River flow (and tidal flushing in the flow lane near the Tongue Point site) are likely to alleviate exposure to the discharged material (Wilber and Clark 2001). Consequently, the likelihood that a juvenile or adult salmon would be harmed or killed by entrainment during flow lane disposal is low.

Based on migration timing and the 1 August through 15 December IWWW, summer- and fall-run adult salmonids and subyearling juveniles could encounter downward falling sediment plumes during flow lane disposal. We estimate the magnitude of exposure and the likelihood of entrainment for these fish by the expected days of operation and the frequency of dredging, combined with the volume of material to be dredged and then released in the flow lane (Table 2). Therefore, we anticipate that flow lane disposal will reduce the fitness of exposed individuals over the 25-year period of dredging activities.

Exposure and Response of Green Sturgeon to Entrainment

Green sturgeon are likely to be in the lower reaches of the Columbia River estuary during April or May through October. Hansel et al. (2017) reported that numbers detected on acoustic arrays were highest in August and September. This indicates that some adults and sub-adults could be in the vicinity of dredging and flow lane disposal activities at Tongue Point and Elochoman Slough, which are within or close to the saline zone of the lower river.

The sub-adult and adult green sturgeon that gather in non-natal Pacific Northwest estuaries range between 2.5 and 8.5 feet in length (Moser et al. 2016). Although highly mobile and known to make vertical migrations in the water column, these fish exhibit behaviors that increase their risk

[6] The USACE would dispose of any sediments that are not approved for in-water disposal (i.e., due to contaminant concentrations that exceed screening levels) in upland areas.

of entrainment. As benthic feeders they are most often found on or near the bottom, while foraging or moving within river and estuarine systems. In Grays Harbor and Willapa Bay, adults and sub-adults were captured in the deepest available habitats, but made forays over the mud flats to feed (O. Langness, Washington Department of Fisheries, Vancouver, WA, unpublished data; cited in Moser et al. 2016).

Although the entrainment of sub-adult and adult sturgeon by suction dredging is relatively rare,[7] it has been documented in projects on the east coast. During hydraulic dredging in Delaware River Ship Channel, a 5.7-foot long Atlantic sturgeon was fatally entrained in 2014, and a 3-foot long short nose sturgeon was fatally entrained in 2017 (NMFS 2017d). A 4-foot long Atlantic sturgeon was also fatally entrained in a hopper dredge operating in the Charleston Entrance Channel in April 2016 (USACE 2016, as cited in NMFS 2018b). Five Atlantic sturgeon were entrained and killed during the first two years of dredging in Savannah Harbor, Georgia, despite pre-trawling the dredging area and capturing and releasing 17 Atlantic sturgeon. NMFS hypothesized that these sturgeon were exposed to entrainment because the project included sustained intense dredging within a relatively small area. Sturgeon also may have been attracted to the newly-dredged area if it stirred up benthic organisms and provided good foraging habitat. These conditions could pertain to dredging in the side channels, especially because maintenance has been deferred for a numbers of years and benthic organisms such as burrowing shrimp and clams may be present.

Green sturgeon are most likely to be in the lower Columbia River and exposed to dredging activities during the first months of the IWWW, August and September. Similar to salmonids, we are unable to estimate the number of green sturgeon that will be entrained and injured or killed. We estimate the magnitude of exposure and the likelihood of adverse response of green sturgeon to entrainment during dredging by the volume of material to be dredged at each site, the expected days of operation per dredging event, and the frequency of dredging (Table 2). The risk is very low for the Oregon Slough and Lake River project areas because of their distance from the mouth of the river. Therefore, we anticipate that a few green sturgeon will experience fitness level consequences during each dredging event over the 25-year action.

We expect that low numbers of sub-adult and adult green sturgeon will be affected by the disposal of sediments in the flow lane. These fish remain on or close to the bottom and over 25 years of operations, some individuals could be under a barge at the time of release. Flow lane disposal from a pipeline dredge will result in continuous exposure while the dredge is operating (Wilber and Clark 2001), but river flow (and tidal flushing near the Tongue Point site) is likely to alleviate exposure to discharged sediment. Exposure is also limited by the IWWW; based on migration timing for sub-adults and adults in Pacific Northwest estuaries, exposure to disposal activities would be very low after September.

Thus, the risk that sub-adult or adult green sturgeon would be injured or killed due to entrainment during disposal is low. We estimate the magnitude of exposure and the likelihood of adverse response of green sturgeon to entrainment during sediment disposal by the expected days of operation at each site per dredging event and the frequency of dredging, combined with the volume of material to be released in the flow lane (Table 2). Assuming that flow lane disposal

[7] See, for example, Stanford et al. (2009).

would take place near each dredged side channel, the risk of entrainment is very low for material dredged from the Oregon Slough and Lake River project areas because of their distance from the mouth of the river. Therefore, we anticipate that very few if any green sturgeon would experience reduced fitness due to flow lane disposal over the 25-year period of the proposed action.

Exposure and Response of Eulachon to Entrainment

Adult eulachon begin to enter the Columbia River during December, so that the earliest migrants (before December 15th) could encounter both the dredging equipment and the sediment plumes created during flow lane disposal. If early migrants begin spawning, incubating eggs will also be affected, with the highest risk in Elochoman Slough and Lake River, which are near major spawning areas.

We expect that low numbers of adult eulachon and their eggs would be entrained and killed by the proposed dredging and flow lane disposal activities. The magnitude of exposure and the likelihood of an adverse response to entrainment during dredging are represented by the expected days of operation at each site per dredging event and the frequency of dredging, combined with the amount of material to be dredged (Table 2). For entrainment into sediment plumes during disposal we estimate the magnitude of exposure and the likelihood of adverse response by the expected days of operation at each site per dredging event and the frequency of dredging, combined with the volume of material to be dredged and then released in the flow lane. These are conservative estimates of exposure and of the risk of injury or mortality, because only the earliest migrants and spawners would be present during the IWWW. Therefore, we anticipate reduced fitness to a few individuals that may overlap with dredging footprints over the 25-year action.

2.4.2. Degraded Water Quality

Critical Habitat

Water quality is a feature of critical habitat supporting migration for all juvenile and adult fish considered in this opinion; rearing for LCR and UWR Chinook salmon, CR chum salmon, LCR coho salmon, and LCR steelhead; and over-summering habitat for sub-adult and adult green sturgeon. Water quality is likely to be moderately degraded during dredging and disposal activities. Degradation will take the form of temporary increases in suspended sediments (measured as turbidity) and at least in the case of Tongue Point, the mobilization of small amounts of the contaminant diethyl phthalate into the water column. Where the material within the dredge prism is high in silt and clay (e.g., 53 percent for the inner shoal at Tongue Point, 50 percent at Elochoman Slough, and 41 percent at Lake River; Table 6), dredging may mobilize organic material and temporarily reduce dissolved oxygen levels in the water column. The amount of sediment that will be suspended in the water column, as well as the duration and extent of a turbidity plume will depend on the composition of the sediments, the method of dredging, and the movement of the water (including tidal forces). The finer the sediment, the longer those particles will remain suspended. The faster the current, the greater distance the turbidity plume will extend from the activity, although at lower suspended sediment concentrations.

We are unable to estimate the concentrations of suspended sediment that dredging the side channels may generate, or the length of time different concentrations are likely to persist. The amount of suspended sediment will also depend on the type of dredge used. Both mechanical and hydraulic dredges may be used in the side channels depending upon availability and cost (USACE 2021). Using a hydraulic dredge would reduce the potential for large turbidity plumes within the side channels because the mobilized sediments are sucked into the dredge. Conversely, the clamshell and backhoe buckets used during mechanical dredging would mobilize sediments across the full depth of the water column as the equipment is pulled through the water. The turbidity plumes from dredging and in-water disposal of sands (e.g., the outer shoal at Tongue Point and the Lake River dredge prism; Table 6) are expected to be both localized and short-lived (hours) compared to the finer-grained sediments mobilized at the other project sites, which would stay suspended for longer periods of time (i.e., more hours).

The USACE will periodically analyze bottom sediments in these side channels for contaminants over the 25-year term of the proposed action. If dredged sediments are contaminated, such as the diethyl phthalate detected in two of the 93 Dredged Material Management Units sampled at Tongue Point in November 2019 (USACE 2021), these compounds will be mobilized into the water column during dredging. The affected sediments from Tongue Point have undergone bioassay testing and are suitable for in-water disposal per the USACE's Sediment Evaluation Framework (USEPA 2021).

Mobilization of anaerobic sediments into the water column may cause an oxygen demand that decreases dissolved oxygen (DO) levels (Hicks et al. 1991, Morton 1977). However, the dispersal of excavated material in the flow lane is not likely to decrease dissolved oxygen concentrations in the mainstem.

Based on their presence in the action area during the IWWW, the influence of these reductions in water quality varies for the 15 species. There will be small, temporary reductions in the water quality component of the migration corridor PBF within the dredging prisms and at the flow lane disposal sites, for up to 900 feet downstream (and 900 feet upstream in areas with tidal influence) for brief periods each year over the 25-year duration of the proposed action for the following PBFs:

- LCR Chinook salmon—juvenile and adult migration corridors
- UCR spring-run Chinook salmon—juvenile migration
- UWR Chinook salmon—juvenile migration corridor
- SR spring/summer Chinook salmon—juvenile and adult migration corridors
- SR fall Chinook salmon—juvenile and adult migration corridors
- CR chum salmon—adult migration corridor
- LCR coho salmon—juvenile and adult migration corridors
- SR sockeye salmon—juvenile migration corridor
- MCR steelhead—juvenile migration corridor
- UCR steelhead—juvenile migration corridor
- UWR steelhead—juvenile migration corridor
- SR steelhead—juvenile migration corridor

- SDPS green sturgeon—sub-adult and adult migration corridors (to over-summering habitat)
- SDPS eulachon—adult migration, spawning and incubation sites

In addition, water quality in rearing areas will be temporarily diminished each year during the IWWW for LCR and UWR Chinook and CR chum salmon. Although there is significant uncertainty regarding the extent and magnitude of the negative effects, the short-term nature of the exposure indicates that the functioning of the water quality component of rearing sites will not be substantially affected.

Exposure and Response of Salmonids to Degraded Water Quality
Water quality reductions due to dredging and disposal activities will occur when summer- and fall-migrating adult salmon (LCR Chinook [fall- and late-fall run populations], SR spring/summer Chinook [summer-run populations], SR fall Chinook, CR chum, and LCR coho) and subyearling LCR and UWR Chinook and CR chum salmon are present (Appendix). Some individuals from each of these ESUs will be present during dredging and disposal activities and thus exposed to altered water quality. Water temperatures during August and early September, the early part of the IWWW, are some of the warmest in the lower Columbia River, often exceeding 70°F in recent years. Thus, some individuals are likely to experience thermal stress contemporaneous with the effects of the proposed action.

The USACE will limit exposure to increased levels of suspended sediments by implementing turbidity monitoring, and pausing dredging activities when levels exceed background by the amounts specified in the proposed action (see Table 3). As a result, we expect that exposures to elevated sediment concentrations will be brief and will elicit only low-level responses such as avoidance of the turbidity plume, and temporary minor physiological responses such as gill flaring (coughing), temporarily reduced feeding rates and success, and moderate levels of stress. Therefore, we do not anticipate fitness consequences to adult summer and fall migrants.

Juvenile salmonids are more sensitive to suspended sediment than adults, and warm water increases their sensitivity. Their metabolic demand for oxygen increases with the need to perform repeated coughing, but warm water holds less dissolved oxygen (Muck 2010). Under these circumstances (e.g., during dredging activities in August and September), even small increases in oxygen demand (e.g., for stress responses and avoidance of the turbidity plume), can result in reduced foraging capability; reduced growth and resistance to disease; physical abrasion; clogging of gills; and interference with orientation in homing and migration (Kjelland et al. 2015).

Where dredging has been deferred and the fine sediment proportion is high (e.g., the inner shoal at Tongue Point and at Lake River), organic carbon is likely to have accumulated. The resuspension of these types of sediments within a semi-enclosed side channel can decrease dissolved oxygen in the water column due to the need for oxygen to decompose the organic material (Kjelland et al. 2015). Avoidance reactions, observed when dissolved oxygen levels drop below 8.0 mg/l (WDOE 2002), could drive small juveniles rearing in these areas from preferred foraging areas, exposing them to increased risk of predation. Hostetter et al. (2012) found that the susceptibility of steelhead to Caspian tern predation increased significantly during periods of decreased water clarity (increased turbidity), along with other factors. Thus, small numbers of LCR and UWR Chinook salmon and CR chum salmon that are rearing in these channels are likely to experience reduced fitness, especially if the exposure is contemporaneous with elevated temperatures, due to degraded water quality.

Carlson et al. (2001) used hydroacoustics to document the behavioral responses of salmonids to dredging activities in the mainstem Columbia River (e.g., the flow lane). The responses of out-migrating smolts (likely fall Chinook and coho salmon) included moving inshore when they encountered dredging operations and moving offshore when they encountered the discharge plume. These fish assumed their former distributions within a short time, indicating that they could avoid areas where suspended sediment concentrations were above background. Thus, we expect that larger juvenile salmonids moving downstream in the flow lane during the IWWW will be able to avoid areas of reduced water quality and will not experience reduced fitness.

We do not expect adverse decreases in dissolved oxygen at the flow lane disposal sites where the material will be quickly dispersed and diluted.

Although we expect that most of the sediments that would be dredged will be free of contaminants, diethyl phthalates have been detected in two of 93 Dredged Material Management Units at Tongue Point. Adults and juveniles that are present in at least that part of the action area during the IWWW would be exposed to mobilized material for very brief periods before it moved downstream and became diluted in the water column. We do not expect that any of these individuals will experience decreased fitness.

We estimate the magnitude of exposure and the likelihood of adverse response of juvenile and adult salmonids to degraded water quality by the expected days of operation at each site per dredging event and the frequency of dredging, combined with the volume of material to be released in the flow lane (Table 2).

Exposure and Response of Green sturgeon to Degraded Water Quality
Green sturgeon are relatively tolerant of elevated suspended sediment concentrations. They are typically found in turbid conditions, and forage by stirring up sediments to access benthic prey such as burrowing shrimp. Wilkens et al. (2015) demonstrated that closely related Atlantic sturgeon experienced no significant effects from three days of continuous exposure to suspended sediment concentrations of up 500 mg/L. Their tolerance of relatively high levels of suspended sediment suggests that this exposure would not affect the fitness of sub-adult or adult fish during the proposed dredging and disposal activities.

Green sturgeon in the Tongue Point side channel are likely to be exposed to low concentrations of diethyl phthalate during dredging of 2 of the 93 Dredge Material Management Units at that site. We expect the exposure of green sturgeon to be so brief, before that material moves downstream and becomes diluted in the water column, that it will not affect individual fitness.

Green sturgeon could also be affected by contaminants that have been taken up by benthic prey, especially if the act of dredging makes these organisms more available. The long life span and late age at maturity of green sturgeon make them vulnerable to chronic and acute effects of bioaccumulation. A fish contaminant survey of the Columbia River basin between 1996 and 1998 found white sturgeon to have the highest contaminant concentrations of all the species tested, including various salmonids, two sucker species, walleye, pacific lamprey and eulachon (USEPA 1999). Because of their extensive marine migratory phase, green sturgeon are less exposed to concentrated anthropogenic contaminants than white sturgeon, but the potential for exposure increases when green sturgeon enter freshwater during summer (COSEWIC 2004). We expect that the proposed dredging, especially in the Tongue Point and Elochoman Slough side channels, closer to the ocean, would expose small numbers of individuals to low concentrations of contaminants, with very minor effects on fitness.

Some sub-adult and adult green sturgeon could briefly be exposed to waters within the side channels with reduced DO during dredging activities. The effects of this exposure are uncertain, but could include reduced swimming and foraging and avoidance of the area. However, the number of exposed individuals is likely to be low, and they are unlikely to experience reduced fitness given their relatively large size and mobility.

Dredging has been deferred at the proposed sites for a number of years, and especially where the fine sediment proportion is high (the inner shoal at Tongue Point and Elochoman Slough), anaerobic sediments may have accumulated. We expect exposure to low dissolved oxygen concentrations to be very brief and the effects on sub-adult and adult green sturgeon would most likely be temporary avoidance of the affected area with no detectable effects on the fitness of an exposed individual.

We estimate the magnitude of exposure and the likelihood of adverse response of sub-adult and adult green sturgeon to degraded water quality by the expected days of operation at each site per dredging event and the frequency of dredging, combined with the volume of material to be released in the flow lane (Table 2).

Exposure and Response of Eulachon to Degraded Water Quality

Many eulachon exposed to dredging-related suspended sediments would most likely be moving past the dredging sites during their upstream migration. The duration of their exposure to turbidity above background levels would be measured in minutes or a few hours. However, adults migrating to spawning areas in the Elochoman River are likely to experience longer exposures. Because eulachon are known to spawn, and larvae survive, in naturally turbid glacial rivers in Alaska (NMFS 2017c). Thus, we expect exposure to elevated suspended sediments to elicit only low-level behavioral effects in adults such as avoidance of the sediment plume, and temporary minor physiological effects such as gill flaring (coughing), temporarily reduced feeding rates and success, and moderate levels of stress. We anticipate little to no consequence to individual fitness of adults and their eggs.

If dredged sediments are contaminated (e.g., the diethyl phthalates in two of the 93 Dredge Material Management Units at Tongue Point), these compounds would be mobilized into the water column during dredging and disposal. Eulachon and any eggs present during December, at the start of the spawning run, could then be exposed to contaminants. However, exposure would be very brief before that material moved downstream and became diluted in the water column.

Effects on the condition of adults and eggs in the side channels or the flow lane disposal sites are expected to be minor, with no consequences to fitness.

Some adults and eulachon eggs could be exposed to waters within the side channels with reduced dissolved oxygen during dredging activities. The effects of this exposure are uncertain, but could include reduced swimming and foraging of adults and possible avoidance of the area. Eulachon will not be present during summer, when warm temperatures exacerbate dissolved oxygen conditions. In addition, the number of exposed individuals is likely to be low. Some early spawners could lay eggs in areas that will be exposed to reduced dissolved oxygen conditions during dredging, but those eggs are likely to be lost due to disruption of the benthos in any case. Therefore, we anticipate minimal consequences of reduced dissolved oxygen concentrations to the fitness of individuals.

The planktonic prey of adult eulachon could be affected by degraded water quality, but the degree of effect is unknown. We anticipate that eulachon will forage in other areas, away from the degraded water quality with little effect on individual fitness.

In summary, we expect that low numbers of adult eulachon and their eggs would be exposed to degraded water quality during the proposed dredging and flow lane disposal activities. We estimate the magnitude of exposure and the likelihood of an adverse response during dredging by the expected days of operation at each site per dredging event and the frequency of dredging, combined with the amount of material to be dredged (Table 2). For exposure to degraded water quality during disposal we estimate the magnitude of exposure and the likelihood of adverse response by the expected days of operation at each site per dredging event and the frequency of dredging, combined with the volume of material to be dredged and then released in the flow lane (Table 2). These are conservative estimates of exposure and of the risk of injury or mortality, because only the earliest migrants and spawners would be present during the IWWW.

2.4.3 Altered Benthic Habitat and Reduced Foraging Opportunity

Critical Habitat

Prey is a biological feature of the juvenile salmonid migration corridor and rearing habitat PBFs. We have preliminary information on the benthic community in the secondary channel behind Woodland Islands before dredged material placement and at two nearby reference sites (Sather 2020). The Woodland Islands samples were dominated by amphipods and nematodes and the reference sites by insects (mostly chironomids), annelid worms, and bivalves. The amphipods that were abundant in these channels are an important salmonid prey item, but are relatively rare in the floodplain wetlands (Kidd et al. 2019, PNNL and NMFS 2020). Thus, removal of sediment from the dredge prisms for this project is likely to affect the availability of prey for juvenile salmonids. This is especially likely in the Tongue Point, Lake River, and Oregon Slough channels, which have not been dredged in many years, so the benthic communities have been able to develop. Elochoman Slough was dredged in 2019 and the current status of the prey community in that channel is unknown.

Dredging and in-water disposal of sediments both alter benthic habitat by removing or smothering infaunal and epifaunal organisms. In doing so, these activities simplify the character of the substrate and alter benthic community structure. The effect that repeated dredging has on prey availability will depend on the frequency of disturbance and the recovery time of the benthos. McCabe et al. (1998) sampled in the mainstem ferry channel between Puget Island and the main navigation channel in the lower Columbia River, and at two nearby shoreline reference sites after a single dredging event. Unlike the areas to be dredged in the proposed action, none of these locations were semi-enclosed side channels, and the habitat in each was mostly sand. The most common benthic species were the bivalve, *Corbicula*, the amphipod, *Corophium*, and dipteran fly larvae. Sampling in the months both before and after dredging indicated no significant effects on community structure; benthic invertebrates recolonized the area very quickly. Jones and Stokes (1998) thought that recolonization of a semi-enclosed channel leading to a shipping terminal in Elliot Bay, Puget Sound, would depend on interactions between sediment parameters, timing of exposure, chance arrival of recruiting fauna, sediment/organic-matter flux to the benthos, and habitat modification caused by the colonizing species themselves (e.g., sediment stabilization, adult-larval interactions, etc.). They stated that the complexity of these factors and the small number of previous studies on recolonization made it impossible to accurately predict community development patterns in their study area. Based on a few studies from other locations, they expected that relatively stable communities would become established after a minimum of 1 to 3 years.

Given the lack of information specific to recolonization of the benthos in a side channel and the uncertainties described by Jones and Stokes (1998), the time over which a benthic community that supports foraging by juvenile salmonids would recolonize is highly uncertain. We expect that the Tongue Point channel, which the USACE proposes to dredge every year, will remain in a state of reduced function (i.e., reduced prey resources) over the entire 25-year period of the proposed action and beyond. The Oregon Slough channel, which would be dredged an average of one year out of five (potentially two years in a row, but no more than five times over the 25-year term of the proposed action), would be more likely to recover, but then become degraded again for unknown periods of time. The substrate and community in this side channel are likely to shift back toward that which was present before dredging, but there is high uncertainty regarding whether they will recover sufficiently to serve as a juvenile salmonid rearing area before the next maintenance dredging occurs. The USACE (2021) proposes to dredge Elochoman Slough and Lake River no more frequently than once every three years to allow the benthic community to recolonize and provide forage for juvenile salmonids. As a result, we conservatively assume that both the rearing and migration PBFs for salmonid critical habitat would experience moderate reductions in food availability for some months or years in the Tongue Point and Oregon Slough side channel prisms, and small reductions in availability at Elochoman Slough and Lake River. These moderate to small reductions will slightly diminish the functioning of critical habitat for all 13 ESUs and DPSs of Columbia basin salmonids.

Prey is also a feature of the green sturgeon estuarine areas PBF. We expect that the periodic removal of sediment and benthic organisms will reduce prey in the Tongue Point, and to a lesser extent, Elochoman Slough side channel dredging prism, is needed by sub-adult and adult green sturgeon for foraging, growth, and development, by a small amount.

In addition, we expect small reductions in substrate suitable for egg deposition by eulachon in spawning and rearing areas due to the periodic removal of sediment within each side channel prism.

Exposure and Response of Salmonids to Altered Benthic Habitat and Reduced Foraging Opportunity

The four side channels the USACE proposes to dredge are likely to provide rearing habitat for small subyearling LCR and UWR Chinook salmon and CR chum salmon. Roegner et al. (2021) measured physical habitat opportunity for juveniles entering floodplain wetlands, noting that the floodplain may not be accessible during low tides (at the lower end of the estuary) and low mainstem flows. This indicates that these side channels are likely to provide important habitat when floodplain wetlands are not inundated.

Annual cohorts of juvenile salmonids will rely on these locations for rearing over the 25-year term of the proposed action and beyond, but during that period will encounter prey communities that have been diminished by the proposed action. Some juveniles will be forced to move to different habitats to find prey, increasing the energetic cost of foraging and the risk of exposure to predators. Dredging also has the potential to increase inter- and intraspecific competition for prey resources and for shallow areas for refuge and resting because alternate habitats are likely to be occupied. Grant et al. (1998) found that the territory size and territorial behavior of juvenile Atlantic salmon was a function of prey availability, with territory size increasing at lower prey abundances. When juvenile salmonids are excluded from or avoid an area and move into adjacent areas, competition and territorial behavior may mean that even more juveniles experience reduced access to prey resources with implications for reduced growth and fitness.

In this case, where dredging will occur multiple times at each location over the 25-year term of the proposed action, this will affect several cohorts of each population, especially for LCR and UWR Chinook and CR chum salmon. Reductions in the fitness of individual juveniles from each cohort are expected to repeat each time a side channel is dredged. We expect this to affect subyearlings, as described above, but also yearling fish from lower Columbia and interior ESUs and DPSs that migrate downstream in the spring. These fish are known to feed primarily on chironomids that originate in floodplain wetlands and corophiid amphipods from shoreline habitats such as secondary and side channels (PNNL and NMFS 2020). Thus, we expect moderate reductions in the fitness of individual subyearling LCR and UWR Chinook and CR chum salmon, and small reductions in the fitness of individual yearling fish from interior ESUs and DPSs, with the degree of effect depending on the frequency of dredging and the time it takes the prey community to recover.

The number of individuals of each species of salmonid and the degree to which their health, condition, growth, or survival will be affected by altered benthic habitat and reduced foraging opportunity is highly uncertain. For the purpose of this analysis, we assume that these risks are proportional to the area that will be dredged, combined with the frequency of dredging, at each project site (Table 2). We anticipate that disruption of benthic communities will reduce the fitness of some individuals of each of the salmonid species over the 25-year period of dredging activities.

We do not expect the ability of juvenile salmonids to forage for prey to be affected by flow lane disposal. The flow lane is an area of strong currents, with relatively coarse-grained sediments and frequent hydraulic disturbance. This suggests that the physical environment is not suitable for the development of salmonid prey communities.

Exposure and Response of Green Sturgeon to Altered Benthic Habitat and Reduced Foraging Opportunity

Green sturgeon typically feed in shallow water on benthic invertebrates such as crustaceans (burrowing shrimp are a major component of their diet) and mollusks (Moyle et al. 1992, Moser et al. 2016). They forage by stirring up sediment to access these prey. We expect the proposed annual maintenance dredging at Tongue Point to reduce or eliminate the benthic infaunal community that has developed in the 30 years since that site was last dredged, and to maintain the benthic community in a degraded state. The loss of this prey resource could cause impacts such as reduced growth and condition in individual sub-adult and adult green sturgeon that would otherwise use this area for foraging, although the number of individuals and the degree to which condition or growth would be affected is highly uncertain. The USACE (2021) proposes to dredge the Elochoman Slough side channel no more frequently than once in every three years, up to five times over the term of the proposed action. Elochoman Slough was dredged relatively recently, in 2019, and the benthic community at this site is likely to have recovered to some degree. For each site, we estimate that the risks of reduced condition, growth, or survival are proportional to the area that will be dredged, combined with the frequency of dredging at each site (Table 2). We anticipate that disruption of the benthic community will reduce the fitness of some sub-adult and adult green sturgeon over the 25-year period of dredging activities.

There is even more uncertainty about whether green sturgeon are likely to forage in the deeper parts of the mainstem channel where flow lane disposal will take place. Although sturgeon forage in relatively deep water during their coastal migrations, they seem to feed over shallower areas in Willapa Bay, even in the intertidal (Dumbauld et al. 2008, Moser and Lindley 2007). We estimate that the level of disturbance will be proportional to the area of sediment that will be dredged, combined with the frequency of dredging at each project site. We do not expect that this will cause any individuals to experience decreased fitness.

Exposure and Response of Eulachon to Altered Benthic Habitat

We do not expect the planktonic communities preyed upon by eulachon to be affected by disturbance of the benthic environment. However, spawning success could be affected if dredging removes large amounts of the materials (especially sand) needed for egg adhesion and incubation (NMFS 2017c), or if suspended sediment that settles out after dredging contains contaminants. In the final recovery plan for this DPS, NMFS (2017c) rated dredging in the mainstem a low threat and dredging in spawning tributaries a moderate threat to recovery. Of the four side channels considered in this opinion, Elochoman Slough is connected to the Elochoman River and Lake River is just upstream of the Lewis River confluence, spawning areas that could be affected by suspended sediments that settle out during dredging. However, the material from this site that was tested in 2018 was determined suitable for unconfined aquatic exposure and disposal. The other spawning tributaries are farther from the four side channels and are unlikely to be affected by the proposed sediment removal activities. We therefore anticipate that dredging will cause reductions in the fitness of some individual adults and their eggs, estimated by the area that will be dredged, combined with the frequency of dredging, at each project site (Table 2).

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. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4). Over the 25-year period of the proposed action, we could expect that some of the climate effects described in the baseline, such as warming water temperatures or increasing variability of volume (low flows, high flows) will become more pronounced. These effects could increase food web disruptions, migration success, or other stresses on any or all of the listed species that rely on the action area. In modeling the response of spring- and summer-run Chinook salmon populations from the interior to warming freshwater and ocean conditions, Crozier et al. (2021) hypothesized that dramatic increases in smolt survival will be needed to overcome the negative impacts of climate change on population viability.

Also, state or private activities in the vicinity of the project locations (e.g., recreational boating, fishing, or other water-based recreation) are expected to increase and be a source of cumulative effects in the action area. Additionally, future state and private activities in upstream areas (particularly intensifying land use, and changes in tree cover) are expected to cause habitat and water quality changes that are expressed as cumulative effects. Our analysis considers how future activities in the Columbia River basin are likely to influence habitat conditions in the action area and cumulative effects caused by specific future activities in the vicinity of the project locations.

Approximately six million people live in the Columbia River basin, concentrated largely in urban centers. The 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 2.4). 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. As such, these effects accrue within this action area, though many are generated from actions that occur upstream. As human population grows, the range of effects described here are likely to intensify.

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 reduced 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. Additionally, as human population grows, other non-Federal uses of the river are likely to increase and intensify, such as recreational boating and fishing, and nonpoint stormwater inputs from upland areas. As a result, recovery of aquatic habitat is likely to be slow in most areas, and contemporaneous 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 into the future.

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 add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), 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) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.6.1 Salmonids and their Designated Critical Habitat

With the exception of UCR spring-run Chinook salmon and SR sockeye salmon, which are already considered endangered, each species of salmon and steelhead considered in this opinion is at risk of becoming endangered in the foreseeable future. These species are ESA-listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic (and in some cases, life history) diversity. Several species have lost parts of their historical population structure due to human activities, and the remaining populations face limiting factors in existing habitats. Recent adult returns have been substantially below averages for many populations/MPGs. This downturn is associated with a series of marine heatwaves and their lingering effects, which likely contributes to substantially lower ocean survival rates of juvenile salmon and steelhead. We expect that abundance could further decrease, and extinction risk increase for many ESUs and DPSs due to factors associated with climate change. These include changes in ocean survival; rates of juvenile growth and development; disease resistance; and run timing, spawn timing, etc.

Under the environmental baseline, the fish from the component populations of each ESU and DPS that move through and use the action area will encounter habitat conditions degraded by a modified flow regime; reduced water quality (chemical contamination and elevated summer and fall temperatures); loss of functioning floodplains; and loss of vegetated riparian areas and associated shoreline cover, both in the mainstem and in secondary and side channels; and high predation rates. The USACE routinely dredges sections of the mainstem navigation channel and periodically dredges shoals in nine other secondary and side channel areas. As a result, juvenile LCR and UWR Chinook and CR chum salmon encounter few undisturbed rearing areas in the lower river and less prey is produced that can be used by larger juveniles from the interior as them move through the mainstem. The significance of this degradation is reflected in the limiting factors described in NMFS' recovery plans: insufficient access to floodplain and secondary channels, degraded habitat, loss of rearing space, pollution, and increased predation. These concerns highlight the importance of minimizing entrainment and water quality degradation and protecting any currently functioning rearing and migration habitat.

The proposed action will create additional repeated physical disturbances in the water column during the IWWW, every year at Tongue Point, and in an average of 1 year out of 5 in the other three side channels, over the 25-year term of the proposed action. Entrainment is likely to kill or injure small numbers of subyearling LCR and UWR Chinook and CR chum salmon, sub-adult and adult green sturgeon attracted to the disruption of sediment and the potential suspension of benthic prey, and adult eulachon and their eggs. Water quality will be reduced within the side channels for short periods of time during dredging, but we expect only minor effects on the condition of a few salmonids, green sturgeon, and eulachon and no mortality for any of these species.

Established benthic prey communities will be disrupted, thereby reducing prey availability for subyearling Chinook and chum salmon that rear within these side channels and for larger yearling fish that consume these prey as they migrate in the mainstem. These disruptions are likely to affect the health, growth, and survival of small numbers of subyearling LCR and UWR Chinook and CR chum salmon from multiple populations each year. These affected subyearlings experience increased energetic costs from having to locate alternate prey as well as competing with juveniles that already occupy nearby areas, and experience increased exposure to predators while swimming between feeding areas. Added to the other nine secondary and side channels that the USACE already dredges (NMFS 2012), the disruption of the benthos in these four channels will further limit the availability of this type of juvenile rearing and foraging habitat. These concerns apply to fish rearing in side channel and shoreline areas or moving off the floodplain as described in Roegner et al. (2021). Reduced access to rearing habitat is identified as a limiting factor in the recovery plans for LCR and UWR Chinook salmon (Table 5).

In the context of the status of designated critical habitat and the baseline conditions of the PBF elements that occur within the action area, the functioning of critical habitat for migration and rearing is moderately reduced in the action area under the environmental baseline. The proposed action will temporarily diminish safe migration and water quality, and prey within migration corridors and rearing areas over its 25-year term and may have longer effects in the case of reduced prey availability. These additional disruptions will continue to limit opportunities for the functioning of the PBFs within the side channels to improve over time.

In summary, we find that the effects of the proposed action are not likely to diminish the conservation value of adult migration corridors for any of the 13 species of salmonid. However, the conservation value of juvenile migration corridors is likely to be diminished for LCR Chinook, UCR spring-run Chinook, UWR Chinook, SR spring/summer Chinook, SR fall Chinook, LCR coho, SR sockeye, UCR steelhead, SRB steelhead, MCR steelhead and UWR steelhead. And the conservation value of rearing areas in the side channels is likely to be diminished for LCR Chinook, UWR Chinook, and CR chum salmon. However, even when considered as an addition to the baseline conditions, and together with the cumulative effects, the proposed action is not likely to appreciably diminish the value of designated critical habitat for the conservation roles of migration or rearing. Accordingly, it is NMFS' opinion that the proposed action is not likely to result in the destruction or adverse modification of the value of the action area to provide migration and rearing sufficient for the conservation of LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer Chinook salmon, UWR Chinook salmon, SR fall Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UCR steelhead, SRB steelhead, MCR steelhead, or UWR steelhead.

The habitat disruptions to safe passage, water quality, and prey will be experienced by individual fish of most of the listed salmonid species as juveniles or adults, affecting some populations each year over the 25-year term of the proposed action (annual dredging at Tongue Point), and some less frequently (an average of 1 in every 5 years at Elochoman Slough, Lake River, and Oregon Slough). We expect effects on adults to be limited to relatively small changes in behavior to avoid the dredging and disposal activities and the resulting sediment plumes. However, even during periods of elevated temperatures during late summer and early fall, we do not expect exposure to effects of the proposed action to lead to the injury or mortality of adult migrants.

Juvenile salmonids from all 13 ESUs and DPSs are more likely to have adverse responses to the reduction in availability of benthic prey such as chironomids and amphipods after excavation in the side channels, with an uncertain period before recolonization and the re-establishment of a productive benthic community. We expect that this latter effect, added to bank protection measures that support agriculture and urban development by cutting off the floodplain, plus dredging in nine other side channels in the lower Columbia River (NMFS 2012), further reduce the availability of preferred prey for rearing and migrating fish. These conditions will be maintained by repeated dredging over the 25-year term of the proposed action, causing the displacement of small numbers of juveniles in each side channel, increasing energetic costs and increasing their exposure to predators as they look for alternate sources of prey.

However, even when we consider the current status of the threatened and endangered species and the degraded environmental baseline within the action area, the proposed action's effect in terms of reducing population abundances is likely to be very small, and spread across multiple populations for any of the 13 species. This reduction itself (even annually in the case of dredging at Tongue Point and an average of once every five years in the other three side channels), for 25 years is not expected to affect the abundance, productivity, spatial structure, or diversity of any of the component populations of the ESA-listed species.

The last element in the integration of effects includes a consideration of the cumulative effects anticipated in the action area. When considering the cumulative effects of non-Federal actions, recovery of aquatic habitat from the degraded baseline conditions is likely to be slow in most of the action area, and cumulative effects (from continued or increasing use of the action area) are likely to have a negative impact on habitat conditions, which in turn may cause negative pressure on population abundance trends in the future. We expect the proposed action to have periodic negative effects on rearing conditions for salmonids in the four side channels and that small numbers of juvenile subyearling LCR Chinook salmon and CR chum salmon will be killed by entrainment. However, even when considered as an addition to the baseline conditions, and together with the cumulative effects, the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer Chinook salmon, UWR Chinook salmon, SR fall Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UCR steelhead, SRB steelhead, MCR steelhead, or UWR steelhead.

2.6.2 Southern DPS of Green Sturgeon and Designated Critical Habitat

The essential PBF of southern green sturgeon critical habitat that would be affected by the proposed action is limited to estuarine areas. The attributes of these sites that would be affected by the proposed action are food resources and water quality. By periodic disruption of the benthos, the proposed action would maintain reduced prey availability in the side channels and potentially in the flow lane, and would cause episodic and temporary reductions in water quality. Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term changes in the quality or function of the affected PBF. Therefore, it is NMFS' opinion that the proposed action is not likely to alter habitat features in a manner that undermine the conservation role of habitat in the action area.

The abundance of this DPS is estimated at 2,106 spawning adults, but no data are currently available to establish any trends in population growth or decline. The extinction risk for the DPS is driven by the fact that it consists of a single population that spawns in a limited portion of the Sacramento River basin that has been degraded by land use activities and water diversions. The environmental baseline in the lower Columbia River also has been degraded, in this case by the effects of nearby streambank and shoreline development for urbanization and industry, maritime activities, agriculture, forestry, water diversions, and road building and maintenance.

Dredging-related work in the four side channels will overlap with the later portion of the seasonal presence of adult and sub-adult green sturgeon. We expect that, over the next 25 years, a low but undetermined number of these fish will be fatally entrained during hydraulic dredging and may also be killed by the disposal of dredged sediments in the flow lane. Low numbers of individuals may also be exposed to contaminants and/or water with reduced dissolved oxygen concentrations, but no injury or mortality is expected from these brief exposures. Reduced prey availability in the side channels and potentially along the bottom at the in-water disposal areas may also cause minor impacts on growth in some individuals.

The planned dredging occurs outside of the DPS's spawning habitat in the Sacramento River and will not cause or worsen any of the factors that are believed to limiting the recovery of this species. Although dredging and in-water disposal act to maintain reduced prey availability, especially in the side channels where green sturgeon may congregate and forage during daylight hours, that effect is expected to be very minor. Based on the best available information, the effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to affect viability at the population level. Therefore, even when considered as an addition to the baseline conditions, and together with the cumulative effects, the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of southern DPS green sturgeon.

2.6.3 Southern DPS of Eulachon

The essential PBFs of southern eulachon critical habitat that would be affected by the proposed action are freshwater and estuarine migration corridors. Dredging and disposal activities will temporarily obstruct or decrease safe passage within, and will temporarily reduce water quality within and downstream of each side channel dredging prism and at the flow lane disposal sites. Based on the best available information, the effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term changes in the quality or function of the affected PBFs. Therefore, it is NMFS' opinion that the proposed action is not likely to impair any physical or biological feature of habitat to the degree that the action area will not support the conservation role for which it was designated for southern DPS eulachon.

The abundance of the southern DPS of eulachon is at very low levels throughout its range, including the population segment in the lower Columbia River. There was an abrupt decline in the numbers of eulachon returning to the Columbia River in the early 1990s. These improved briefly in the early 2000s, and then returned to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013 to 2015 return years, recent poor ocean conditions and the concern that these conditions will persist into the future, suggest that populations may continue to decline.

Under the environmental baseline, conditions at the proposed dredging and disposal sites has been degraded by the effects of nearby streambank and shoreline development and by maritime activities. The baseline has also been degraded by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance. Over the next 25 years, low numbers of early migrating adult eulachon and their eggs may be entrained and killed by dredging and may briefly be exposed to elevated levels of suspended sediment and turbidity, contaminants, and reduced dissolved oxygen that are mobilized during dredging and in-water disposal. No injury or mortality is expected in adults from the brief exposures to changes in water quality. We do not expect the planktonic communities preyed upon by eulachon to be affected by either dredging within the side channels or disposal in the flow lane, except through effects on water quality as described above.

The planned dredging and disposal would not worsen any of the factors that are believed to limit the recovery of this species. Based on the best available information, the effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to affect viability at the population level. Therefore, even when considered as an addition to the baseline conditions, and together with the cumulative effects, the proposed action is not likely to reduce abundance in a manner that would appreciably reduce the productivity, spatial structure, or diversity of the southern DPS eulachon. Therefore, even when considered as an addition to the baseline conditions, and together with the cumulative effects, the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of southern DPS Pacific eulachon.

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, UCR spring-run Chinook salmon, SR spring/summer Chinook salmon, UWR Chinook salmon, SR fall Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UCR steelhead, SRB steelhead, MCR steelhead, UWR steelhead, southern DPS green sturgeon, or southern DPS Pacific eulachon, or destroy or adversely modify their designated critical habitats.

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 actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). 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 ITS.

2.8.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

Incidental take in the form of injury or death due to entrainment during dredging and disposal; incidental take in the form of harm from water quality impairments; and incidental take in the form of harm from reduced prey availability.

Due to the repeating nature of the proposed action, the highly variable number of individual fish present at any given time, and difficulties in the ability to observe injury or mortality of fish, which may sink out of site, be consumed by predatory species, or have delayed death outside of the action area. we cannot determine the number of ESA-listed fish that will be killed, injured or otherwise adversely affected. In such circumstances we use a habitat-based surrogate to account for the amount of take, which is called an "extent" of take. The extent of take is causally related to the harm that occurs, and is an observable measure for monitoring, compliance, and re-initiation purposes. These surrogates function as effective reinitiation triggers because they are clear, measurable limits that can be readily monitored for any exceedances, so reinitiation could be triggered at any time during the dredging.

Injury or death from entrainment: the volume of dredged material, the number of days of operation, and frequency of dredging are the best available surrogates for the extent of take of salmonids, green sturgeon, and eulachon from entrainment. This is because entrainment is positively correlated with the volume of material removed and increases with the length and frequency of the operation.

Harm from water quality reductions: The total volume of material to be dredged, the number of days of operation, and the frequency of dredging are the best available surrogates for the extent of take of salmonids, green sturgeon, and eulachon from exposure to elevated levels of suspended sediments and contaminants or low dissolved oxygen. These reductions in water quality would increase with the volume of material removed, and the number of fish exposed would be correlated with the number of days and frequency of dredging.

Harm from reduced prey availability: The total area of material to be dredged and the frequency of dredging are the best available surrogates for the extent of take of salmonids and green sturgeon from reduced prey availability because the lost benthic prey would be positively correlated with these parameters.

Presenting these measurements of take by the areas where they will occur, the extent of take for this action is defined as:

1. Tongue Point
    a. Injury or death of salmonids, green sturgeon, or eulachon by entrainment while dredging up to 800,000 CY per dredging event each year. Each of these dredging events will take up to 137 days and will occur between 1 August and 15 December.
    b. Harm of salmonids, green sturgeon, or eulachon by exposure to degraded water quality while dredging up to 800,000 CY per dredging event each year. Each of these dredging events will take up to 137 days and will occur between 1 August and 15 December.
    c. Harm of salmonids or green sturgeon from reduced availability of benthic prey from dredging up to 75 acres per dredging event each year. Each of these dredging events will take up to 137 days and will occur annually between 1 August and 15 December.

2. Elochoman Slough

a. Injury or death of salmonids, green sturgeon, or eulachon by entrainment while dredging up to 25,000 CY per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action and no more frequently than once every three years. Each of these dredging events will take up to 14 days and will occur between 1 August and 15 December.

b. Harm of salmonids, green sturgeon, or eulachon by exposure to degraded water quality while dredging up to 25,000 CY per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action and no more frequently than once every three years. Each of these dredging events will take up to 14 days and will occur between 1 August and 15 December.

c. Harm of salmonids or green sturgeon from reduced availability of benthic prey from dredging up to 5 acres per dredging event, to occur during no more than 5 times over the 25-year term of the proposed action and no more frequently than once every three years. Each of these dredging events will take up to 14 days and will occur between 1 August and 15 December.

3. Lake River

a. Injury or death of salmonids, green sturgeon, or eulachon by entrainment while dredging up to 34,000 CY per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action and no more frequently than once every three years. Each of these dredging events will take up to 15 days and will occur between 1 August and 15 December.

b. Harm of salmonids, green sturgeon, or eulachon by exposure to degraded water quality while dredging up to 34,000 CY per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action and no more frequently than once every three years. Each of these dredging events will take up to 15 days and will occur between 1 August and 15 December.

c. Harm of salmonids or green sturgeon from reduced availability of benthic prey from dredging up to 5 acres per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action and no more frequently than once every three years. Each of these dredging events will take up to 15 days and will occur between 1 August and 15 December.

4. Oregon Slough

a. Injury or death of salmonids, green sturgeon, or eulachon by entrainment while dredging up to 600,000 CY per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action. Each of these dredging events will take up to 137 days and will occur between 1 August and 15 December.

b. Harm of salmonids, green sturgeon, or eulachon by exposure to degraded water quality while dredging up to 600,000 CY per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action. Each of these dredging events will take up to 137 days and will occur between 1 August and 15 December.

c. Harm of salmonids or green sturgeon from reduced availability of benthic prey from dredging up to 50 acres per dredging event, to occur during no more than 5 years over the 25-year term of the proposed action. Each of these dredging events will take up to 105 days and will occur between 1 August and 15 December.

Dredging operations that are outside of the IWWW will increase the likelihood of more listed individuals being exposed to entrainment and reduced water quality. The volume and area to be dredged, the frequency of dredging, the number of days of dredging per event, and dredging outside of the IWWW are each thresholds for reinitiating consultation. Exceeding any of these indicators for extent of take will trigger the reinitiation provisions of this opinion.

2.8.2 Effect of the Take

In the biological opinion, 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" (RPM) are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The USACE shall require any permittee or contractor performing the work described in this document to:

1. Minimize entrainment during dredging and in-water disposal;
2. Minimize harm from degradation of water quality;
3. Complete an annual 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 USACE and its contractors must comply with them in order to implement the RPMs (50 CFR 402.14). The USACE has 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 ITS (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. The following terms and conditions implement RPM 1, minimize entrainment during dredging and in-water disposal:
    a. Apply these terms and conditions to its own actions when carrying out FNC O&M work, and to the actions of any contractors hired by the USACE for that purpose.
    b. Complete all dredging and in-water disposal during the IWWW of 1 August through 15 December.

c. Require dredge operators to use best available technologies to ensure that dredging and disposal activities are confined to areas within the current official boundaries of the Federal channels and in-water disposal sites.

d. Require dredge operators to limit the dredge prism and the volume of removed sediment to the minimum area necessary to achieve project goals.

e. Require mechanical dredge operators to ensure that the clamshell or backhoe bucket is lowered to the bottom as slowly as feasible to allow ESA-listed fish to escape.

f. Require operators to keep dragheads or cutterheads at, or buried in the substrate when suction dredge pumps are working, and no more than 3.0 feet above the substrate for the minimum time needed to clean or purge the dragheads.

g. Require hydraulic dredge operators to minimize pump operations when dragheads or cutterheads are above the substrate.

h. Discharge material from a pipeline dredge at depths at least 20.0 feet below the surface of the water.

2. The following terms and conditions implement RPM 2, minimize effects on water quality:

a. Apply these terms and conditions to its own actions when carrying out FNC O&M work, and to the actions of any contractor hired by the USACE for that purpose.

b. Require dredge operators to comply with the current ODEQ or WDOE water quality monitoring plan(s) issued for the site.

c. Require dredge operators to monitor turbidity and comply with the following:

i. A properly and regularly calibrated turbidimeter is recommended, but visual turbidity gauging is acceptable.

ii. Locations of turbidity samples or observations must be identified and described in the USACE's water quality monitoring plans. At a minimum, monitoring must take place at the following distance, and within any visible plumes:

1. Dredging and in-water (flow lane) disposal activities - Up-current (background) and 900 feet down current from the point of discharge (bucket, backhoe, hopper, or pipeline), and no more than 150 feet laterally from the vessel.
2. If a meter is used, the USACE must identify a depth between 10 and 20 feet, or at mid-depth in water less than 20 feet in depth, to collect all sample readings.

iii. Monitoring must occur when dredging and disposal is being conducted and must meet the following requirements:

1. Active dredging–once a day during a flood tide and once a day during an ebb tide.
2. In-water disposal–once a day during a flood tide and once during an ebb tide.
3. Background turbidity NTU or observation, location tidal stage, and time must be recorded before monitoring down-current.

iv. The USACE and any dredging contractors, shall ensure turbidity in the side channels remains at background levels 900 feet downstream from the point of disturbance during dredging operations by adhering to the measure to monitor turbidity and respond to exceedances as proposed in the project description. This shall include monitoring and compliance reporting of turbidity levels observed during dredging operations as required by the States of Oregon and Washington's CWA section 401 certifications.

d. Require dredge operators to monitor dissolved oxygen concentrations and comply with the following:
   i. Sample dissolved oxygen at the mid-point of the water column, 300 feet down current from the dredge and in the turbidity plume if visible.
   ii. Collect samples during daylight hours during active dredging at the following frequency: once a day during a flood tide and once a day during an ebb tide.
   iii. Sample dissolved oxygen concentrations with a dissolved oxygen meter that is properly and regularly calibrated according to the owner's manual.
   iv. Dredging shall not begin if dissolved oxygen concentrations at the dredge site are less than 6.5 mg/l.
   v. If the level of dissolved oxygen measured is below 8 mg/l, the monitoring frequency must increase to every four hours until the level returns above 8 mg/l.
   vi. If the measured level of dissolved oxygen is below 6.5 mg/l, or if distressed or dead fish are observed in or beside the dredge, the activity must be stopped until the level returns to above 6.5 mg/l.
   vii. Restricted visibility: During periods of restricted visibility that could cause an unsafe condition, the Corps may postpone required compliance monitoring until conditions improve if confirmation is made by a third party, such as the Coast Guard Watch Stander or the National Weather Service, that the visibility in the area to be monitored is considered to be restricted and is unsafe to conduct the required monitoring. If monitoring is postponed due to restricted visibility and unsafe conditions, the weather condition, time of determination, and verification route must be recorded. Regular monitoring must resume once the visibility returns to safe levels.

3. The following terms and conditions implement RPM 3, complete an annual 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.
   a. Require dredging operators to maintain and submit dredging logs to verify that all take indicators are monitored and reported. Minimally, logs should include: (1) type of dredging vessel (mechanical, hydraulic pipeline, hopper); (2) vessel position relative to the side channel while dredging, or certification that dredging was within the authorized channel, and the methods used to confirm vessel location; volumes of sediment removed/disposed; (4) extent of turbidity plumes, compliance with the Water Quality Monitoring Plan; and (5) all observed incidents of entrainment of listed species.

b. Establish procedures for the submission of observer and dredge operator logs, and other materials, to the appropriate USACE office, which will draft and submit annual monitoring reports.

c. Establish procedures for reporting take and annual monitoring reports, along with results from any DMMP sediment testing of material from the four side channels, to include any exceedances of turbidity or dissolved oxygen compliance levels and active or passive methods used to re-attain compliance, along with results from any sediment testing of material from the four side channels.

d. Submit email take reports to:
projectsreports.wcr@noaa.gov
Include WCRO-2020-02918 in the subject line.

e. Submit annual monitoring reports for the preceding calendar year by April 1st to NMFS at the following address:
projectreports.wcr@noaa.gov
Attn: WCR-2020-02918

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 recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the USACE:

1. Regularly require use of floating silt curtains around the in-water dredge area or the use of an environmental bucket for mechanical dredging in the side channels to minimize the dispersion of suspended sediment, thereby reducing the spread of high levels of suspended sediments into adjacent areas.

2. Narrow the conditions under which maintenance dredging is allowed so that benthic habitat can more completely recover between dredge occurrences. For example, dredging would not be allowed without a showing that sediments are accumulating or have accumulated to an extent that they threaten to impair navigation or berthing.

3. Narrow the IWWW to reduce the duration of activities with risk of entrainment and reduced water quality.

4. Consult with NMFS under Section 7(a)(1) to create a mitigation bank to offset impacts associated with the regular exercise of its authority allowing impacts to the nation's waters.

5. Monitor and evaluate the ecological importance of these areas to the viability and recovery of the Columbia River subpopulation of Pacific eulachon to promote the conservation of the species and address uncertainties regarding the effects of dredging in side channels on spawning and incubation in the lower Columbia River.

6. Conduct before and after macro-benthic community structure analysis in the Elochoman Slough and Lake River dredge prisms to determine the benthic community response (taxa, diversity, richness, and abundance) at 1, 3, and 6 months following dredging. Work with NMFS to identify additional opportunities for this type of monitoring for future side channel dredging projects in the lower Columbia River.

Please notify NMFS if the USACE carries out these recommendations 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

This concludes formal consultation for Federal Navigation Channel Operations and Maintenance Dredging: Tongue Point, Clatsop County, Oregon; Elochoman Slough, Wahkiakum County, Washington; Lake River, Clark County, Washington; and Oregon Slough, Multnomah County, Oregon.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service 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 taking specified in the ITS 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 identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA , EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and 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) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)]

This analysis is based, in part, on the EFH assessment provided by the USACE and that conducted by NMFS, and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council [PFMC] 2005) and, coastal pelagic species (CPS) (PFMC 1998), Pacific Coast salmon (PFMC 2014); and highly migratory species (PFMC 2007) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce. In this case, NMFS concluded the proposed action would not adversely affect EFH for coastal pelagic species and highly migratory species. Thus, consultation under the MSA is not required for these habitats.

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 the biological opinion. The action area includes areas designated EFH for various life-history stages of two Pacific Coast salmon species: Chinook salmon and coho salmon (PFMC 2014). Habitat areas of particular concern (HAPC) within the action area include estuaries and channel habitat (PFMC 2005, 2014).

Freshwater EFH for Pacific Coast salmon (Chinook and coho) consists of four major components: 1) spawning and incubation, 2) juvenile rearing, 3) juvenile migration corridors, and 4) adult migration corridors and holding habitat, and overall, can include any habitat currently or historically occupied within Washington, Oregon, and Idaho. The important components of Pacific salmon marine EFH are: 1) estuarine rearing, 2) ocean rearing; and 3) juvenile and adult migration. The only marine EFH habitat for salmon found within the action area for this consultation is the estuarine habitat in the lower Columbia River. Estuarine EFH for Chinook and coho salmon found within the action area for this consultation includes juvenile rearing, juvenile migration corridors, and adult migration corridors and holding habitat (PFMC 2014). In addition, estuaries provide protected, nutrient-rich, and biologically productive habitat for groundfish (PFMC 2020).

3.2. Adverse Effects on Essential Fish Habitat

As described in detail in the preceding opinion, the proposed action is expected to affect EFH components in four side channels and in the mainstem Columbia River, including the saltwater portion of the estuary. We conclude that the proposed action will have the following adverse effects on EFH designated for Pacific Coast Salmon:

1. The proposed dredging and disposal activities will temporarily reduce water quality (suspended sediments and the mobilization of contaminants and potentially, low dissolved oxygen).

2. The proposed dredging in the side channels will reduce the quantity and quality of benthic prey communities.

The proposed action will have the following adverse effects on EFH designated for Pacific Coast Groundfish:

1. The proposed dredging and disposal activities will temporarily reduce water quality (suspended sediments and the mobilization of contaminants and potentially, low dissolved oxygen).
2. The proposed dredging activities will affect sediment characteristics in the side channels for uncertain periods of time.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

To minimize the effects of the proposed dredging and disposal activities on Pacific Coast Salmon and Pacific Coast Groundfish EFH, including the estuaries HPAC, the USACE should:

(1) To minimize water quality impacts, limit the dispersion of suspended sediment from a side channel while using a clamshell or backhoe dredge, by regularly requiring use of floating silt curtains around the in-water dredge area or the use of an environmental bucket for mechanical dredging if turbidity levels are exceeded.

(2) To reduce effects on the benthic prey eaten by salmonids and juvenile groundfish such as flatfishes, conduct before and after macro-benthic community structure analysis in areas less than 20-feet deep within the Elochoman Slough and Lake River dredge prisms to determine the benthic community response (taxa, diversity, richness, and abundance) at 1, 3, and 6 months following dredging. Work with NMFS to identify opportunities for this type of monitoring for future side channel dredging projects. Based on findings, adjust the frequency of dredging to accommodate prey recolonization rates.

(3) To reduce effects on the benthic prey community and sediment characteristics, allow maintenance dredging to occur within the 25-year term of the proposed action only on a showing that sediments have accumulated or are accumulating in a manner that threatens to impair navigation or berthing.

(4) Consult with NMFS under Section 7(a)(1) to create a mitigation bank to offset impacts associated with the regular exercise of its authority allowing impacts to the nation's waters.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, approximately 105 acres of designated EFH and HAPC for Pacific Coast salmon and groundfish.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USACE 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 the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise 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 USACE 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. FISH AND WILDLIFE COORDINATION ACT

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development (16 USC 661). The FWCA establishes a consultation requirement for Federal agencies that undertake any action to modify any stream or other body of water for any purpose, including navigation and drainage (16 USC 662(a)), regarding the impacts of their actions on fish and wildlife, and measures to mitigate those impacts. Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources, and providing equal consideration for these resources. NMFS' recommendations are provided to conserve wildlife resources by preventing loss of and damage to such resources. The FWCA allows the opportunity to provide recommendations for the conservation of all species and habitats within NMFS' authority, not just those currently managed under the ESA and MSA.

The following recommendations apply to the proposed action:

1. Regularly require use of floating silt curtains around the in-water dredge area or the use of an environmental bucket for mechanical dredging in the side channels to minimize the dispersion of suspended sediment, thereby reducing the spread of high levels of suspended sediments into adjacent areas.

2. Narrow the conditions under which maintenance dredging is allowed so that benthic habitat can more completely recover between dredge occurrences. For example, dredging would not be allowed without a showing that sediments are accumulating or have accumulated to an extent that they threaten to impair navigation or berthing.

3. Narrow the IWWW to reduce the duration of activities with risk of entrainment and reduced water quality.

4. Consult with NMFS under Section 7(a)(1) to create a mitigation bank to offset impacts associated with the regular exercise of its authority allowing impacts to the nation's waters.

5. Monitor and evaluate the ecological importance of these areas to the viability and recovery of the Columbia River subpopulation of Pacific eulachon to promote the conservation of the species and address uncertainties regarding the effects of dredging in side channels on spawning and incubation in the lower Columbia River.

6. Conduct before and after macro-benthic community structure analysis in the Elochoman Slough and Lake River dredge prisms to determine the benthic community response (taxa, diversity, richness, and abundance) at 1, 3, and 6 months following dredging. Work with NMFS to identify additional opportunities for this type of monitoring for future side channel dredging projects in the lower Columbia River.

The USACE must give these recommendations equal consideration with the other aspects of the proposed action so as to meet the purpose of the FWCA.

This concludes the FWCA portion of this consultation.

5. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (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.

5.1 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 U.S. Army Corps of Engineers and any contractors it uses for dredging and disposal activities, the Oregon Department of Environmental Quality, and the Washington State Department of Ecology. Other interested users could include the Cowlitz Indian Tribe, the Nez Perce Tribe, Ports, recreational and commercial vessel owners, and recreational or commercial fishers. Individual copies of this opinion were provided to the USACE, the Cowlitz Indian Tribe, and the Nez Perce Tribe. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

5.2 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.

5.3 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 and 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

Table A-1. Presence of ESA-listed fish species in the lower Columbia River by life stage. Work window months are highlighted in orange.

=present = relatively abundant = peak occurrence

Species	Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eulachon													
Southern	Adult migr. & holding[1, 2]												
DPS	Adult spawning[2]												
	Egg incubation[3]												
	Larvae emigration												
Green Sturgeon													
Southern DPS	Sub-adult and adult foraging												
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												
Spring/Summer	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 River	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[5]												
	Juvenile emigration[6]												
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												
Willamette	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

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