UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
501 West Ocean Blvd., Suite 4200
LONG BEACH, CALIFORNIA 90802

Refer to NMFS No:
WCRO-2022-03092

April 22, 2024

Todd Tillinger
Chief, Regulatory Branch
U.S. Army Corps of Engineers, Seattle District
4735 East Marginal Way South, BLDG 1202
Seattle, Washington 98134-2388

Re: Endangered Species Act Section 7(a)(2) Jeopardy Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Issuance of Permits for No Name Slough Tidegate Replacement Project in Skagit County, Washington (NWS-2020-195)

Dear Mr. Tillinger:

We received your emails of April 7, 2022, (No Name Slough Tidegate Replacement project) 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 replacement of tidegates in Skagit County, Washington.

On February 1, 2024, the project applicant filed a motion for preliminary injunction requesting the court order NMFS to issue a biological opinion by April 1, 2024. On March 8, 2024, the court granted the District's request and ordered NMFS to complete formal consultation before April 1, 2024. On March 29, 2024, the Court granted the parties' stipulated motion to extend the April 1, 2024, deadline to submit a final biological opinion. Pursuant to that Court order, NMFS sent a draft biological opinion to Plaintiff, as well as the Army Corps of Engineers (USACE) and three Tribal entities, the Upper Skagit, Swinomish, and Sauk-Suiattle on April 1, 2024. NMFS received comments from the Plaintiff, USACE, and the Swinomish Indian Tribal Community on April 11, 2024, and has reviewed and responded, as appropriate, within this Opinion.

We have determined that the USACE's proposed action, to permit the No Name Slough tidegate project, is likely to jeopardize the continued existence of listed Puget Sound (PS) Chinook salmon and Southern Resident killer whales (SRKW). The proposed action also is likely to adversely modify those species' designated critical habitats. We also determined that the proposed action is likely to adversely affect, though not likely to jeopardize, listed PS steelhead. PS steelhead critical habitat is not designated in the action area.

Our opinion includes a Reasonable and Prudent Alternative (RPA) to the proposed action that, if implemented, will not jeopardize PS Chinook salmon or SRKW or adversely modify those species' designated critical habitats.

As required by section 7 of the ESA, we have provided an incidental take statement with the biological opinion. The incidental take statement describes reasonable and prudent measures that NMFS considers necessary or appropriate to minimize incidental take of PS Chinook salmon, PS steelhead and SRKW associated with the proposed action, as modified by the RPA. The incidental take statement also includes terms and conditions that must be followed by the USACE and/or the applicant in order to be exempt from the prohibitions of section 9 of the ESA. If the entity to whom a term and condition is directed does not comply with the terms and conditions, protective coverage for the proposed action would likely lapse.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast salmon and coastal pelagic species. Therefore, we have included the results of that review in Section 3 of this document.

Please direct any questions regarding this consultation to David Price, consulting biologist in the National Marine Fisheries Service's Lacey, Washington, office at david.price@noaa.gov.

Sincerely,

Jennifer Quan
Regional Administrator
West Coast Region

cc: Randel Perry, Project Manager, United States Army Corps of Engineers, Seattle District
Kelly Werdick, Project Manager, United States Army Corps of Engineers, Seattle District

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

Issuance of a Permit under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act for the No Name Slough Tidegates Replacement Project in the Nearshore Environment of Puget Sound, Skagit County, Washington
(NWS-2020-195)

NMFS Consultation Number: WCRO-2022-03092

Action Agency: U.S. Army Corps of Engineers

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?**
PS steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	NA	NA
PS Chinook salmon (*O. tshawytscha*)	Threatened	Yes	Yes	Yes	Yes
Southern Resident Killer Whale (*Orcinus orca*)	Endangered	Yes	Yes	Yes	Yes

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
Coastal Pelagic species	Yes	Yes

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

Issued By:

Jennifer Quan
Regional Administrator
West Coast Region

Date: April 22, 2024

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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 part 402, as amended.

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 at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file in Lacey, Washington.

1.2 Consultation History

A project very similar to the proposed action was previously the subject of a separate programmatic ESA consultation, which is no longer in effect. In the interests of providing some historical context for the present consultation, we provide information here about that prior consultation. In 2009, NMFS issued a programmatic biological opinion (NMFS, 2009) analyzing the 2008 Tidegate and Fish Initiative ("TFI") Agreement (WWAA et al. 2008). The TFI was a regional tidegate initiative involving a range of stakeholders including industry, state, and federal agencies, with the Swinomish Tribe participating as a non-voting member on the TFI Oversight Committee.

In the TFI Agreement, analyzed in NMFS 2009 opinion, tidegate projects were determined to require a certain number of habitat restoration credits (measured as acres) and the Agreement required the credits to be provided before tidegate projects could proceed. The restoration acres/credits for each tidegate were based on the number of delta acres affected and were tied to recovery goals under the PS Chinook Salmon Recovery Plan. The credits allocated to each tidegate in order to generate the total restoration acreage were set out in the TFI Agreement (Table 4-2). In the TFI Agreement, the No Name Slough tidegates proposed for replacement (at tidegate complex 103) were determined to influence 207 delta acres of and to warrant 8.6 acres of credits.

The TFI Agreement defined Minor, Major, and Replacement projects and these categories dictated the extent to which credits would be required for projects at each tidegate. Minor repair required no credits; major repairs required half the credits allocated to the complex; and, replacement projects required all the credit allocated. Any tidegate project "that require[d] excavation of the dike or levee to accomplish the repair" exceeded the definition of Major project and was defined as a Replacement project. In addition, major projects were expected to require 10 cubic yards or less of rock armoring to restore the original footprint of the rock.

Operational improvement projects were separately defined as those "actions that primarily improve fish passage" and they could be used to generate credits which could be retained for use by the relevant District. Operational improvement projects included replacement of conventional tidegates or tier 1 floodgates with a side hinge gate.

NMFS' biological opinion described and analyzed the effects of the scheme set out in the TFI Agreement (NMFS, 2009):

> To stimulate restoration of the necessary acreage, the Western Washington Agricultural Association proposed coupling tidegate maintenance activities with restoration projects identified in the Skagit Chinook Recovery Plan. Therefore, the restoration goal was set at 2,700 acres of estuarine habitat. To ensure that restoration projects and tidegate maintenance would proceed simultaneously, the proposed action would enable permit issuance under the provisions of this programmatic opinion (i.e. without project-specific ESA consultation) so long as the necessary habitat restoration "credits" are in hand to justify permit issuance. If credits are not available, the applicant will be required to complete a project-specific ESA consultation on any proposed action. Credits required for individual tidegate actions are based upon the total area behind the tidegate (Table 4-2 of IA). Half of the designated credits are necessary for a major repair and all of the credits are required for a replacement.

In the years following issuance of NMFS' opinion on the TFI Agreement, the TFI Oversight Committee began interpreting tidegate projects with elements that improved on past conditions as being Operational Improvements, even if they would otherwise fall under the definition of a Major Project or Replacement project.[1] On this basis, the credit allocation for the applicable tidegate(s) was revised to zero. The No Name Slough project was one such project, with this determination made on November 18, 2019. Due in part to such interpretations of the TFI Agreement, progress toward the restoration goals specified in the TFI Agreement and assumed in NMFS' biological opinion was much slower than expected. NMFS began discussions about these concerns with TFI Agreement signatories and the action agency, the United States Army Corps of Engineers (Corps or USACE) and ultimately, on September 29, 2021, NMFS sent a letter to USACE recommending reinitiation of the TFI biological opinion. On November 3, 2021, the USACE requested reinitiation, and the TFI programmatic biological opinion was no longer considered an operable opinion for future projects. The No Name Slough project had not been permitted at that point in time, and so the applicant was advised by USACE to request individual consultation.

On April 7, 2022, NMFS received a request for informal consultation from USACE for the proposed action at No Name Slough (Table 1). The Corps had apparently transmitted the request on February 28, 2022, but it was not received due to file size limitations. Upon review of the information provided, we determined that the information did not demonstrate that the effects of the proposed action are either wholly beneficial, discountable, or insignificant. Therefore, NMFS could not concur with the Corps' not likely to adversely affect (NLAA) determination for PS Chinook salmon and its designated critical habitat, or its NLAA determination for PS steelhead.

[1] For examples, see 60 Day Notice of Intent to Sue sent by Earthjustice to NMFS on behalf of the Swinomish Indian Tribal Community on September 9, 2021, pp 8-10.

We electronically provided a non-concurrence letter to the Corps on December 14, 2022, that included a request for the Corps to consider a formal consultation.

Table 1. Proposed No Name Slough tidegate replacement project.

NMFS Consultation #	USACE Identification # (NWS #)	Project Name	Georeferenced location of project site	Consultation Request Date
WCRO-2022-03092	NWS-2020-195	No Name Slough	Latitude 48.46944° N Longitude -122.46901°W	4/7/2022

Subsequently, the Corps requested formal consultation for the proposed action on December 16, 2022. The consultation request includes the original February 28, 2022, Memorandum for the Services (MFS) and informal consultation request letter; an emergency declaration from the Commissioners of Skagit County Dike, Drainage, and Irrigation Improvement District No. 12 (DID 12), a Washington special purpose district, dated September 9, 2019; a Biological Assessment (BA); and project drawings. NMFS also requested additional information on November 17, 2022, which was received from Jenna Friebel on November 18 and November 21, 2022. Upon review, we determined that the information provided by the Corps included the necessary information to complete ESA Section 7 and EFH consultation, and formal consultation was initiated on December 16, 2022.

On December 21, 2023, the project applicant, DID 12, filed a complaint against the NMFS with the United States District Court, Western Washington District (Case 2:23-cv-01954) alleging NMFS had failed to complete ESA consultation in a timely manner. On February 1, 2024, DID 12 filed a motion for preliminary injunction requesting the court order NMFS to issue a biological opinion by April 1, 2024. NMFS opposed the motion, requesting until July 3, 2024, due to factors such as the complexity of the consultation, significant human resource constraints, and time needed for external coordination. However, on March 8, 2024, the court granted the DID 12's request and ordered NMFS to complete formal consultation before April 1, 2024, allowing 15 business days to complete the consultation after the order was issued. A subsequent March 29, 2024, Order extended that deadline until April 22, 2024 to allow the applicant to comment on a draft. NMFS received comments from the applicant, the USACE, and the Swinomish Tribe, on April 11, 2024, and has considered all information received, and responded, as appropriate, throughout this Opinion, as well as in Appendix 4. This Opinion is based on the best scientific and commercial information available.

Updates to the regulations governing interagency consultation (50 CFR part 402) published April 5, 2024, but are not effective until May 6, 2024 (89 Fed. Reg. 24268). As a result, we are continuing to apply the currently effective regulations (i.e., up to and including the regulations adopted for section 7 in 2019 (84 Fed. Reg. 44976 (August 27, 2019)). For purposes of this determination and in an abundance of caution, we considered whether the analysis or its conclusions would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions presented here would not be any different.

Table 2. ESA-listed species and critical habitat effect determinations by NMFS and the Corps for the No Name Slough Tidegate replacement project.

Species	Status	NMFS		Corps		Listed / CH Designated
		Species	CH	Species	CH	
PS Chinook salmon (*Oncorhynchus tshawytscha*) (NMFS 2006)	Threatened	LAA	LAA	NLAA	NLAA	06/28/05 (70 FR 37160) / 09/02/05 (70 FR 52630)
PS steelhead (*O. mykiss*) (NMFS 2019)	Threatened	LAA	NA	NLAA	NE	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)
Southern Resident Killer Whale (*Orcinus orca*) (NMFS 2008b)	Endangered	LAA	LAA	NE	NE	11/18/05 08/02/21 (86 FR 41668)

NE is 'no effect '; NLAA is 'may affect, not likely to adversely affect'; LAA is 'may affect, likely to adversely affect'; NA is 'not applicable' because steelhead critical habitat has not been designated in marine waters of Puget Sound.

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 (see 50 CFR 402.02).

The Corps is proposing to permit, under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act, tidegate replacement activities at No Name Slough (Figure 1) (discussed in detail below). The effects of this action are the consequences caused by the Corps' decision to grant the permit that would not occur but for that decision and that are reasonably certain to occur (see also Section 2.4.1, Distinguishing Baseline from Effects of the Action). Permits allowing in and near water structures in the nearshore and estuaries of the Salish Sea to be repaired or replaced generally extend the time those existing structures will exist on the landscape and thus, their effects on species and their habitat. At the same time, currently existing that are yet to-be-repaired, rebuilt and/or replaced are part of the environmental baseline conditions, and in many cases, would persist for some period of time regardless of a request for a USACE permit. Our analysis differentiates between effects that are part of the baseline and effects that are caused by the proposed action. In the case of No Name Slough, based on the information submitted by the applicant and USACE documenting the state of the structure to be repaired/replaced, NMFS assumes that the structure has 10 years of remaining life and this is reflected in our analysis. This approach is consistent with assumptions made in the Salish Sea Nearshore Programmatic Consultation (NMFS 2022c) and other similar consultations[2] (see

[2] In most cases, NMFS assumes a "10-year" time period as a default assumption for consultations where the project may have a remaining "useful life period." NMFS developed this assumption through input from marine

NMFS 2020, NMFS 2021, and NMFS 2022b). We discuss these assumptions further in the description of the Environmental Baseline (Section 2.4) below.

Based on these assumptions, our effects analysis thus focuses on how the proposed action will extend the useful life of the repaired and replaced structure, and any associated effects, into the future. Here, based on what we know about the life of the structures and the proposed action, we assume the proposed repair and replacement project will extend the useful life of the structures being rebuilt by 50 years.[3] We discuss this approach in more detail in the Effects of the Action Section 2.5 below.

As stated above, the proposed action is the USACE's issuance of a permit for the No Name Slough tidegate project, consisting of several components. The USACE permit would authorize the project under the Clean Water Act and/or Rivers and Harbors Act. The project replaces existing shoreline armoring[4] and associated tidegate structures with a single shoreline armoring/tidegate structure in Puget Sound. Two existing culverts will be removed and two others will be replaced with a single large concrete split box culvert structure with two side-hinged tidegates (Figure 1).

Currently, No Name Slough flows south and westerly through the project area and under a rip-rapped earthen dike through two parallel 4-foot-wide round culverts with top-hinge tidegates before discharging into Padilla Bay. This structure is the primary discharge point for No Name Slough into Padilla Bay. A pump house building is located on the landward side of these two culverts. Ditch 1 is an otherwise unnamed drainage ditch, which flows southeast into the project area and into No Name Slough at the pump house structure location. Another 4-foot-wide round culvert with a top-hinge tidegate is located approximately 250 feet northwest of the primary discharge point for No Name Slough and drains a portion of flows within Ditch 1 to Padilla Bay. A fourth culvert (a wooden box culvert) has already failed and has been partially decommissioned.

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industry stakeholders and the Corps while working to implement the mitigation calculator that supported the RGP-6/Structure in Marine Waters Programmatic (NMFS 2016c).

[3] NMFS based the assumed duration of the new "useful life period" on RGP-6/Structure in Marine Waters Programmatic (NMFS 2016c), as referenced in footnote 1, as well as input from consultants that regularly assist applicants through permitting processes (Ehinger et al. 2023, Appendix E) and our best professional judgment. Depending on design, engineering, and materials, useful life periods could also be shorter or longer. For this consultation we applied the 50-year assumption, as described above.

[4] The terms shoreline armoring, dike, and riprap are used interchangeably throughout this document to describe the structures at the project site..

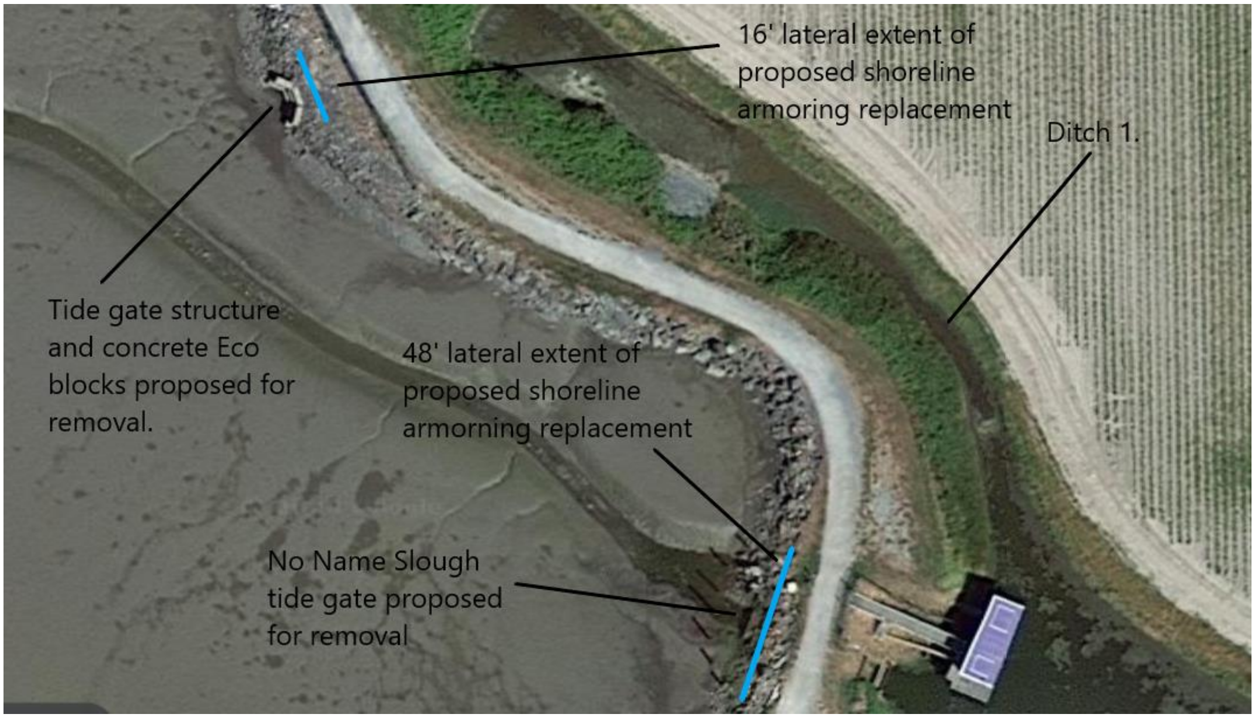

Figure 1. No Name Slough tidegate replacement site at the confluence with Padilla Bay at low tide. The tidegate in the center of this photo has been partially removed and the area filled with material.

The proposed action would enable the applicant to remove three existing tidegates and associated culverts in two locations and replace them with one large concrete split box culvert with two 4.0-foot by 5.83-foot side-hinge gates in one location. Under the proposed permit, the project will be implemented in two phases: (1) remove and replace (with a single concrete split box culvert) the two parallel 4-foot-wide round culverts currently discharging flows from No Name Slough to Padilla Bay and remove two creosote piles (Figure 2) and the associated trash rack (Figure 3), and (2) remove two culverts in Ditch 1 (Figure 1). A contractor will conduct the replacement work for the two main discharge culverts at the confluence of No Name Slough, and DID 12 will remove the culverts from Ditch 1. The Ditch 1 culverts will not be removed until after the No Name Slough tidegates have been replaced (GeoEngineers 2022). A total of 73.6 cy[5] of new riprap on the marine shoreline of Padilla Bay is anticipated for the project (GeoEngineers 2022). Total shoreline armoring is proposed to include 62 linear feet of large rock and 23 linear feet of vertical concrete structural support for the tidegates. The project will include a sheet pile isolation area (fish relocation plan described below) to construct the project, of which approximately 330 square feet (33 feet long by 10 feet deep) is proposed to be left permanently submerged below the substrate at the shoreline face of the project[6]. In their memo to NMFS,

[5] The 73.6 cubic yard number is from the description of the action in the Biological Assessment; the numbers referenced in the November 18, 2022, email referenced in District Comment 1 on the Draft Opinion only apply to one part of the project site, but not other parts, which include additional new armoring as described on page 2 of the November 18, 2022 email.

[6] This permanent sheet pile piece does not affect the output of the Nearshore Calculator. Use of the Calculator, as part of our assessment, is fully described below.

dated February 28, 2022, the Corps determined that the in-water work would be conducted between July 16 and February 15 to minimize impacts to ESA-listed species.

Approximately seven creosote treated wood piles are located in Padilla Bay immediately west of the outlets of the two parallel 4-foot-wide round culverts that drain No Name Slough. Under the proposed action, the applicant would remove two of these piles, at low tide to enable worksite dewatering. Dewatering of the site will include the installation of a coffer dam and pumping system prior to casting in-place a concrete split box culvert (GeoEngineers 2022). Best management practices (BMPs) are described in GeoEngineers (2022) and are incorporated here by reference and described briefly below.

Figure 2. No Name Slough tidegate at the confluence with Padilla Bay with high tide line represented by aquatic debris. Photo credit: Jenna Friebel.

Figure 3. Trash Rack (approximately 12 feet wide) on the Slough side of the No Name Slough tidegate. The trash rack is proposed for removal. Photo credit: Jenna Friebel.

Best management practices (BMPs), which we assume will be followed, are described in detail in GeoEngineers (2022) from available project plans and emails, and include:

- All work will be conducted in the dry where appropriate and at least 3 feet above the waterline otherwise;
- No construction debris or deleterious materials may be disposed of or abandoned on-site;
- All equipment for excavation of the existing structure will be staged on the dike above the OHWM;
- Excavated material will be temporarily stockpiled in the grassy upland field south of the tidegates;
- The contractor will prepare a Spill Prevention and Emergency Cleanup Plan (SPECP) for this project, and adequate materials and procedures to respond to unanticipated weather conditions or accidental releases of materials (sediment, petroleum hydrocarbons, etc.) will be available on site;

- Disturbed areas of the streambank and dike will be hydro-seeded with a native seed mix after construction completion;
- Erosion control measures will be implemented.

Fish isolation and removal would occur as follows:
- Fish removal will only be conducted on an outgoing tide
- Block nets will be set up to isolate the work area
- The isolated work area will be inspected (moving rocks as needed to flush fish) for stranded and trapped fish. Any observed fish will be removed with sanctuary dip nets.
- Once fish exclusion netting has been installed and fish have been removed from the work area, silt curtains will be installed along the inside of the fish exclusion netting.
- Before work begins on the second day of in-water work, a biologist will conduct a sweep of the isolated work area using sanctuary dip nets to confirm that no fish have emerged from refugia within the isolated work area overnight.

We considered, under the ESA, whether the proposed action would cause any other activities. We determined that it would cause the future operation and maintenance of the tidegate facility including routine and minor maintenance of the tidegates, of marine rip rap and waterway rip rap. Although dredging, either behind or waterward of the tidegate, might be necessary in the future, we assume that dredging would require authorization by the Corps as it involves discharge of material into waters of the U.S. We will analyze any effects of future dredging in a separate, future consultation. Also, the proposed action would cause the operation of the tidegates, which changes the interchange of salt and freshwater behind the tidegate, essentially maintaining what would be a salt marsh estuary as a brackish slough enabling habitat behind to be managed for agriculture. In this way, the project precludes the development of a certain amount of estuary habitat behind the tidegate by precluding the physical and biological process that allow for development of this type of habitat.

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 to 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 reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

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 for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214, February 11, 2016).

The designation(s) of critical habitat for PS Chinook salmon and SRKW use the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the 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 ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision 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 range-wide 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 critical 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.

Our analytical approach utilizes best available qualitative and quantitative methods to evaluate the effects of the action. Specifically, in addition to our usual qualitative approaches, we employ a Habitat Equivalency Analysis (HEA) methodology and our Puget Sound Nearshore Habitat Values Model (NHVM) to evaluate certain enduring effects of the shoreline armoring component of the proposed action on the marine side of the structure. NMFS has been using the Puget Sound Nearshore Habitat Calculator (Calculator, or Nearshore Calculator) as a user interface to the NHVM and HEA for various projects that affect the Puget Sound nearshore environment, a tool that can quantify “debits" that identify a measure of how much a project affects nearshore habitat function. NMFS has used the Nearshore Calculator in similar contexts to this project (See, e.g., (NMFS 2020, NMFS 2021, NMFS 2022b), and NMFS 2022c (Salish Sea Nearshore Programmatic). Although the Calculator can evaluate the loss of nearshore habitat resulting from the shoreline armoring, it is not currently able to evaluate all effects of the action. In particular, the Calculator is not able to assess impacts behind/landward of the dike, including loss of access to habitat. We employ other best available and qualitative approaches to assess these impacts, as we would for other similar actions in Puget Sound or other areas on NMFS’s West Coast Region.

NMFS’s Nearshore Calculator was recently peer reviewed by an independent expert panel who found that the Nearshore Calculator is based on best available science and generates reasonable and well-supported outputs.[7] This tool and underlying model was used to quantify the enduring in-water and riparian habitat effects on the marine side of the shoreline armoring component of the proposed action on ESA listed salmonids. Impacts are expressed in Conservation Debits which equal Discounted Service Acre Years (DSAYs)*100. The Nearshore Calculator does not evaluate any short- or medium-term effects, including construction effects (e.g., sheet pile driving or turbidity) or ongoing maintenance, and it does not evaluate freshwater effects. Habitat equivalency, which forms the basis of the Nearshore Calculator, is a concept that uses a common ecological currency (DSAYs) to express and assign a value to functional habitat loss and gain. Ecological equivalency is traditionally a service-to-service approach where the ecological functions and services for a species or group of species lost from an impacting activity can be fully offset by the services gained from a conservation activity.[8] In this case, we use this approach to quantify the impacts of certain enduring effects of the proposed action on the marine side of the tidegates.

Output from the Nearshore Calculator accounts for the following consequences of the action on the marine side of the tidegate:

- Beneficial aspects of the proposed project, including any positive nearshore effects that would result from removing certain structures, here, creosote piles;
- Minimization of effects incorporated through project design improvements
- Adverse effects caused by the proposed action on the marine side of the structures (here, resulting from the shoreline armoring component of the project), that are expected to occur for the duration of a new useful life of that armoring and associated tidegate.

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[7] https://www.fisheries.noaa.gov/west-coast/habitat-conservation/independent-peer-review-noaa-fisheries-puget-sound-nearshore

[8] NMFS has a webpage with general information, frequently asked questions, and a downloadable Nearshore Calculator and User Guide here: https://www.fisheries.noaa.gov/west-coast/habitatconservation/puget-sound-nearshore-habitat-conservation-calculator.

We applied the following assumptions and inputs to the Calculator:

- The remaining useful life of the existing riprap armouring is 10 years (*see* Section 2.4.1 for additional explanation);
- The useful life of the new tidegate and shoreline armoring structures is 50 years (*see* Section 2.4.1. and 2.5 for additional explanation);
- Riparian plantings have a relatively low success rate over time, which is especially likely on the rip rap shoreline of Padilla Bay and No Name Slough; and,
- Two creosote piles will be removed, which will be disposed of at an approved upland facility.

Further details about our quantitative assessment of the enduring effects on nearshore habitat are set out in Appendix 1.

Other resources used to inform this Opinion include:

- SalmonScape –Washington Department of Fish and Wildlife's interactive, computer mapping system of salmon habitat data at https://apps.wdfw.wa.gov/salmonscape/map.html
- USGS The National Map - Elevation Tool “Profile Tool” to determine gradation of potential fish habitat at https://apps.nationalmap.gov/elevation/
- Washington Department of Ecology Water Quality Assessment Tool at https://apps.ecology.wa.gov/waterqualityatlas/wqa/
- Washington Department of Natural Resources Aquatic Resources Interactive Map – Aquatic Reserves at https://aquarim.dnr.wa.gov/default.aspx
- Washington Department of Ecology’s Washington Coastal Atlas Map at https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that is likely to 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” for the jeopardy analysis. 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. Major ecological realignments are already occurring in response to climate change (IPCC WGII, 2022). Long-term trends in warming have continued at global, national and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09°C higher than the 1850-1900 baseline period, with larger increases over land ~1.6°C compared to oceans ~0.88°C (IPCC WGI, 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI, 2021). Globally, 2014-2018 were among the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA and NCEI 2022). The year 2023 was the highest global temperature on record by far among all years between 1850 – 2023 (NOAA 2024a). Events such as the 2013-2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors are often examined in isolation, but likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC WGI, 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refugia (both flow and temperature), and improving growth opportunities in both freshwater and marine environments are strongly advocated in the recent literature (Siegel and Crozier 2020).

Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier 2015, 2016, 2017, Crozier and Siegel 2018, Siegel and Crozier 2019, 2020) have collected hundreds of papers documenting the major themes relevant for salmon. Here we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

Forests

Climate change will impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreak (Halofsky et al. 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018) projected that the largest changes will occur at low- and high-elevation forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizedeh et al. 2021).

Agne et al. (2018) reviewed literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

Freshwater Environments
The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

Cooper et al. (2018) examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter's precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, inter-annual variability in winter precipitation was greater. Malek et al. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable.

The effect of climate change on ground water availability is likely to be variable. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

Isaak et al. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon *O. nerka* and the availability of suitable habitat for brown trout *Salmo trutta* and rainbow trout *O. mykiss*. Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald et al. 2020, Myers et al. 2018).

Streams with intact riparian corridors and that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018), identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in short time-spans by removing riparian cover (Koontz et al. 2018), and streams that lose their snowpack with climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan et al. 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments
Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne et al. 2021). California and Oregon showed the greatest threat to tidal wetlands (100 percent), while 68 percent of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat. Global sea levels are expected to continue rising throughout this century, reaching predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011; Reeder et al. 2013). Estuarine-dependent salmonids, such as chum and Chinook salmon, are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007). Further, changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011; Reeder et al. 2013).

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life history traits and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux et al. 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (although see Ou et al. 2015 and Williams et al. 2019), however, impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower stream flows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford 2022, Lindley et al. 2009, Williams et al. 2016, Ward et al. 2015). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier et al. 2019).

Climate change effects on salmon and steelhead

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact inter-gravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier et al. 2020). Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for Evolutionarily Significant Units (ESU) or Distinct Population Segments (DPS) with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (Crozier et al. 2020, FitzGerald et al. 2020). Rising river temperatures increase the energetic cost of migration and the risk of *en route* or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refugia and run-timing plasticity to reduce thermal exposure (Keefer et al. 2018, Barnett et al. 2020).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Holsman et al. 2012, Burke et al. 2013). It is generally accepted that salmon marine survival is size-dependent, and thus larger and faster growing fish are more likely to survive (Gosselin et al. 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco et al. 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018), explored phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon *O. nerka* from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris et al. (2018) recommended that managers maintain and augment such life-history diversity.

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al. 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner et al. 2018, Kilduff et al. 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger et al. 2018). Other Pacific salmon species (Stachura el al. 2014) and Atlantic salmon (Olmos et al. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Healey 2011; Wainwright and Weitkamp 2013, Gosselin et al. 2021). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter and spring adult migrants, such as coho salmon and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel 2006; Crozier et al. 2010, Crozier et al. 2019).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook salmon from the mid-Columbia than those from the Snake River Basin. In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater et al. 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al. 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al. (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al. 2019, Munsch et al. 2022).

2.2.1 Status of the Species

For Pacific salmon, steelhead, and certain other species, we commonly use the four "viable salmonid population" (VSP) criteria (McElhany et al. 2000) to assess the viability of the populations that, together, constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits (McElhany et al. 2000).
"Abundance" generally refers to the number of naturally produced adults (i.e., the progeny of naturally spawning parents) in the natural environment (e.g., on spawning grounds).

"Productivity," as applied to viability factors, refers to the entire life cycle (i.e., the number of naturally-spawning adults produced per parent). When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fails to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, we assess the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

On October 4, 2019, NMFS published notice of NMFS' intent to initiate a new 5-year status review for 28 listed species of Pacific salmon and steelhead and requested updated information from the public to inform the status review (84 FR 53117). On March 24, 2020, NMFS extended the public comment period, from the original March 27, 2020, through May 26, 2020 (85 FR 16619). The Northwest Fishery Science Center (NWFSC) completed the Viability Risk Assessment for salmon and steelhead (Ford 2022). NMFS' West coast Regional Office (WCRO) is currently preparing the final 5-year status review documents, with anticipated completion in 2024. In this section, where possible, particularly as new material becomes available, the latest final (2016) status review information is supplemented with more recent information and other population specific data that may not have been available during the 2016 status review, including some of the information in the draft 2024 status review, so that NMFS is assured of using the best available information for this opinion.

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the geographic area of the proposed projects and are considered in this opinion. More detailed information on the status and trends of these listed resources, and their biology and ecology, is in the listing regulations and critical habitat designations published in the Federal Register (Table 3) and is incorporated here by reference.

Status of Puget Sound Chinook Salmon

The recovery plan for PS Chinook salmon consists of two documents: the Puget Sound salmon recovery plan (SSPS 2007) and a supplement by NMFS (2006). The recovery plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus et al. 2002). A critical component of recovery requires the viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured. The PSTRT's biological recovery criteria will be met when all of the following conditions are achieved:

- The viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured;
- Two to four Chinook salmon populations in each of the five biogeographical regions of the ESU achieve viability, depending on the historical biological characteristics and acceptable risk levels for populations within each region;
- At least one population from each major genetic and life history group historically present within each of the five biogeographical regions is viable;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario;
- Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and
- Populations that do not meet the viability criteria for all VSP parameters are sustained to provide ecological functions and preserve options for ESU recovery.

Table 3. 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
Puget Sound Chinook salmon	Threatened 6/28/05 (70 FR 37159)	Shared Strategy for Puget Sound 2007	NMFS 2017; Ford 2022	This ESU comprises 22 populations distributed over five geographic areas. All PS Chinook salmon populations continue to remain well below the TRT planning ranges for recovery escapement levels. Most populations also remain consistently below the spawner–recruit levels identified by the TRT as necessary for recovery. Across the ESU, most populations have increased somewhat in abundance since the last status review in 2016, but have small negative trends over the past 15 years. Productivity remains low in most populations. Overall, the PS Chinook salmon ESU remains at "moderate" risk of extinction.	• Degraded floodplain and in-river channel structure • Degraded estuarine conditions and loss of estuarine habitat • Degraded riparian areas and loss of in-river large woody debris • Excessive fine-grained sediment in spawning gravel • Degraded water quality and temperature • Degraded nearshore conditions • Impaired passage for migrating fish • Severely altered flow regime
Puget Sound steelhead	Threatened 5/11/07	NMFS 2019	NMFS 2017; Ford 2022	This DPS comprises 32 populations. Viability of has improved somewhat since the PSTRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Increases in spawner abundance were observed in a number of populations over the last five years within the Central & South PS and the Hood Canal & Strait of Juan de Fuca MPGs, primarily among smaller populations. There were also declines for summer- and winter-run populations in the Snohomish River basin.	• Continued destruction and modification of habitat • Widespread declines in adult abundance despite significant reductions in harvest • Threats to diversity posed by use of two hatchery steelhead stocks • Declining diversity in the DPS, including the uncertain but weak status of summer-run fish • A reduction in spatial structure • Reduced habitat quality • Urbanization

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				In fact, all summer-run steelhead populations in the Northern Cascades MPG are likely at a very high demographic risk.	• Dikes, hardening of banks with riprap, and channelization
Southern resident killer whale	Endangered 11/18/05	NMFS 2008	NMFS 2022a	The Southern Resident killer whale DPS is composed of a single population that ranges as far south as central California and as far north as southeast Alaska. While some of the downlisting and delisting criteria have been met, the biological downlisting and delisting 63 criteria, including sustained growth over 14 and 28 years, respectively, have not been met. The SRKW DPS has not grown; the overall status of the population is not consistent with a healthy, recovered population. Considering the status and continuing threats, the Southern Resident killer whales remain in danger of extinction.	• Quantity and quality of prey • Exposure to toxic chemicals • Disturbance from sound and vessels • Risk from oil spills

Spatial Structure and Diversity.
The PS Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPG), that are based on similarities in hydrographic, biogeographic, and geologic characteristics (Table 4).

Since 1999, most PS Chinook populations have mean natural-origin spawner escapement levels well below levels identified as required for recovery to low extinction risk. Long-term, natural-origin mean escapements for eight populations are at or below their critical thresholds. Both populations in three of the five biogeographical regions are below or near their critical threshold: Georgia Strait, Hood Canal and Strait of Juan de Fuca. When hatchery spawners are included, aggregate average escapement is over 1,000 for one of the two populations in each of these three regions, reducing the demographic risk to the populations in these regions. Additionally, hatchery spawners help two of the remaining three of these populations achieve total spawner abundances above their critical threshold, reducing demographic risk. Nine populations are above their rebuilding thresholds, seven of them in the Whidbey/Main Basin Region. In 2018, NMFS and the NWFSC updated the rebuilding thresholds for several key Puget Sound populations. These thresholds represent the Maximum Sustained Yield estimate of spawners based on available habitat. The new spawner-recruit analyses for several populations indicated a significant reduction in the number of spawners that can be supported by the available habitat when compared to analyses conducted 10 to 15 years ago. This may be due to further habitat degradation or improved productivity assessment or, more likely, a combination of the two. For example, the updated rebuilding escapement threshold for the Green River is 1,700 spawners compared to the previous rebuilding escapement threshold of 5,523 spawners. So, although several populations are above the updated rebuilding thresholds, indicating that escapement is sufficient for the available habitat in many cases, the overall abundance has declined.

Abundance and Productivity.
The abundance of the PS Chinook salmon over time shows that individual populations have varied with increasing or decreasing abundance. Generally, many populations experienced increases in total abundance during the years 2000-2008, and more recently in 2015-2017, but general declines during 2009-2014, and a downturn again in the two most recent years available for the current status review, 2017-2018. Abundance across the Puget Sound ESU has generally increased since the last status review, with only 2 of the 22 populations (Cascade and North Fork and South Fork Stillaguamish) showing a negative percent change in the 5-year geometric mean natural- origin spawner abundances since the prior status review. However, 15 of 20 populations with positive percent change in the 5-year geometric mean natural-origin spawner abundances since the prior status review have relatively low population abundances of <1000 fish, so some of these increases represent small changes in total abundance (Ford 2022). Also, given lack of high confidence in survey techniques, particularly with small populations, there is substantial uncertainty in quantifying fish and detecting trends in small populations (Gallagher et al. 2010).

Table 4. Extant PS Chinook salmon populations in each biogeographic region and percent change between the most recent two 5-year periods (2010-2014 and 2015-2019). Five-year geometric mean of raw natural-origin spawner counts. This is the raw total spawner estimate times the fraction natural-origin estimate, if available. In parentheses, 5-year geometric mean of raw total spawner estimates (i.e., hatchery and natural) are shown. A value only in parentheses means that a total spawner estimate was available but no (or only one) estimate of natural-origin spawners was available. The geometric mean was computed as the product of estimates raised to the power 1 over the number of counts available (2 to 5). A minimum of 2 values were used to compute the geometric mean. Percent change between the most recent two 5-year periods is shown on the far right (Ford 2022).

Biogeographic Region	Population (Watershed)	2010-2014	2015-2019	Population trend (% change)
Strait of Georgia	**North Fork Nooksack River**	136 (1205)	137 (1553)	Positive 1% (29)
	South Fork Nooksack River	13 (35)	42 (106)	Positive 223% (203)
Strait of Juan de Fuca	**Elwha River**	71 (1349)	134 (2810)	Positive 89% (108)
	Dungeness River	66 (279)	114 (476)	Positive 73% (71)
Hood Canal	**Skokomish River**	136 (1485)	265 (2074)	Positive 95% (40)
	Mid Hood Canal River	80 (295)	196 (222)	Positive 145% (-25)
Whidbey Basin	Skykomish River	1698 (2462)	1736 (2806)	Positive 3% (14)
	Snoqualmie River	839 (1082)	856 (1146)	Positive 2% (6)
	North Fork Stillaguamish River	417 (996)	302 (762)	Negative 28% (-23)
	South Fork Stillaguamish River	34 (68)	37 (96)	Positive 9% (41)
	Lower Skagit River	1416 (1541)	2130 (2640)	Positive 50% (71)
	Upper Sauk River	854 (880)	1318 (1330)	Positive 54% (51)
	Lower Sauk River	376 (416)	635 (649)	Positive 69% (56)
	Suiattle River	376 (378)	640 (657)	Positive 70% (74)
	Upper Cascade River	298 (317)	185 (223)	Negative 38% (-30)
Central/South Puget Sound Basin	North Lake Washington/ Sammamish River	82 (1289)	126 (879)	Positive 54% (-32)
	Green/Duwamish River	785 (2109)	1822 (6373)	Positive 132% (202)
	Puyallup River	450 (1134)	577 (1942)	Positive 28% (71)
	White River	652 (2161)	895 (6244)	Positive 37% (189)
	Cedar River	699 (914)	889 (1253)	Positive 27% (37)
	Nisqually River	481 (1823)	766 (1841)	Positive 59% (1)

Trends in abundance over longer time periods are generally slightly negative. Fifteen-year trends in log natural-origin spawner abundance were computed over two time periods (1990-2005 and 2004- 2019) for each Puget Sound Chinook population. Trends were negative in the latter period for 16 of the 22 populations and for four of the 22 populations (SF Nooksack, SF Stillaguamish, Green and Puyallup) in the earlier period. Thus, there is a general decline in natural-origin spawner abundance across all MPGs in the recent fifteen years. Upper Sauk and Suiattle (Whidbey Basin MPG), Nisqually (Central/South MPG) and Mid-Hood Canal (Hood Canal MPG) are the only populations with positive trends, though Mid-Hood Canal has an extremely low population size. Further, no change in trend between the two time periods was detected in SF Nooksack (Strait of Georgia MPG), Green and Nisqually (Central/South MPG). The average trend across the ESU for the 1990-2005 15-year time period was 0.03. The average trend across the ESU for the later 15-year time period (2004-2019) was -0.02. The previous status review in 2015 (NWFSC 2015) concluded there were widespread negative trends for the total ESU despite that escapements and trends for individual populations were variable. The addition of the data to 2018 now also shows even more substantially either flat or negative trends for the entire ESU in natural-origin Chinook salmon spawner population abundances (Ford 2022).

Across the Puget Sound ESU, 10 of 22 Puget Sound populations show natural productivity below replacement in nearly all years since the mid-1980’s. These include the North and South Forks Nooksack in the Strait of Georgia MPG, North and South Forks Stillaguamish and Skykomish in Whidbey Basin MPG, Sammamish, Green and Puyallup in the Central/South MPG, the Skokomish in the Hood Canal MPG, and Elwha in the Strait of Juan de Fuca MPG. Productivity in the Whidbey Basin MPG populations was above zero in the mid-late 1990’s, with the exception of Skykomish and North and South Forks Stillaguamish populations. White River population in the Central/South MPG was above replacement from the early 1980’s to 2001, but has dropped in productivity consistently since the late 1980’s. In recent years, only 5 populations have had productivity estimates above zero. These are Lower Skagit, Upper Skagit, Lower Sauk, Upper Sauk, and Suiattle, all Skagit River populations in the Whidbey Basin MPG. This is consistent with, and continues the decline reported in the 2015 Status Review (NWFSC 2015).

All Puget Sound Chinook salmon populations continue to remain well below recovery levels (Ford 2022). Most populations also remain consistently below the spawner-recruit levels identified by the TRT as necessary for recovery. Across the ESU, most native-origin populations have slightly increased in abundance since the last status review in 2016, but have small negative trends over the past 15 years (Figure 4). Productivity remains low in most populations. Hatchery-origin spawners are present in high fractions in most populations outside the Skagit watershed, and in many watersheds the fraction of spawner abundances that are natural-origin have declined over time. Habitat protection, restoration and rebuilding programs in all watersheds have improved stream and estuary conditions despite record numbers of humans moving into the Puget Sound region in the past two decades. Bi-annual four-year work plans document the many completed habitat actions that were initially identified in the Puget Sound Chinook salmon recovery plan. However, the expected benefits from restoration actions is likely to take years or decades to produce significant improvement in natural population viability parameters (see Roni et al. 2010).

Development of a monitoring and adaptive management program was required by NMFS in the 2007 Supplement to the Shared Strategy Recovery Plan (NMFS 2006), and since the last review the Puget Sound Partnership has completed this, but this program is still not fully functional for providing an assessment of watershed habitat restoration/recovery programs, nor does it fully integrate the essentially discrete habitat, harvest and hatchery programs. A recent white paper produced by the Salmon Science Advisory Group, of the Puget Sound Partnership concludes there has been "a general inability of monitoring to link restoration, changes in habitat conditions, and fish response at large-scales" (PSP 2021). A number of watershed groups are in the process of updating their Recovery Plan Chapters and this includes prioritizing and updating recovery strategies and actions, as well as assessing prior accomplishments. Overall, recent information on PS Chinook salmon abundance and productivity since the 2016 status review indicates a slight increase in abundance but does not indicate a change in biological risk to the ESU despite moderate inter-annual variability among populations and a general decline in abundance over the last 15 years (Ford 2022).

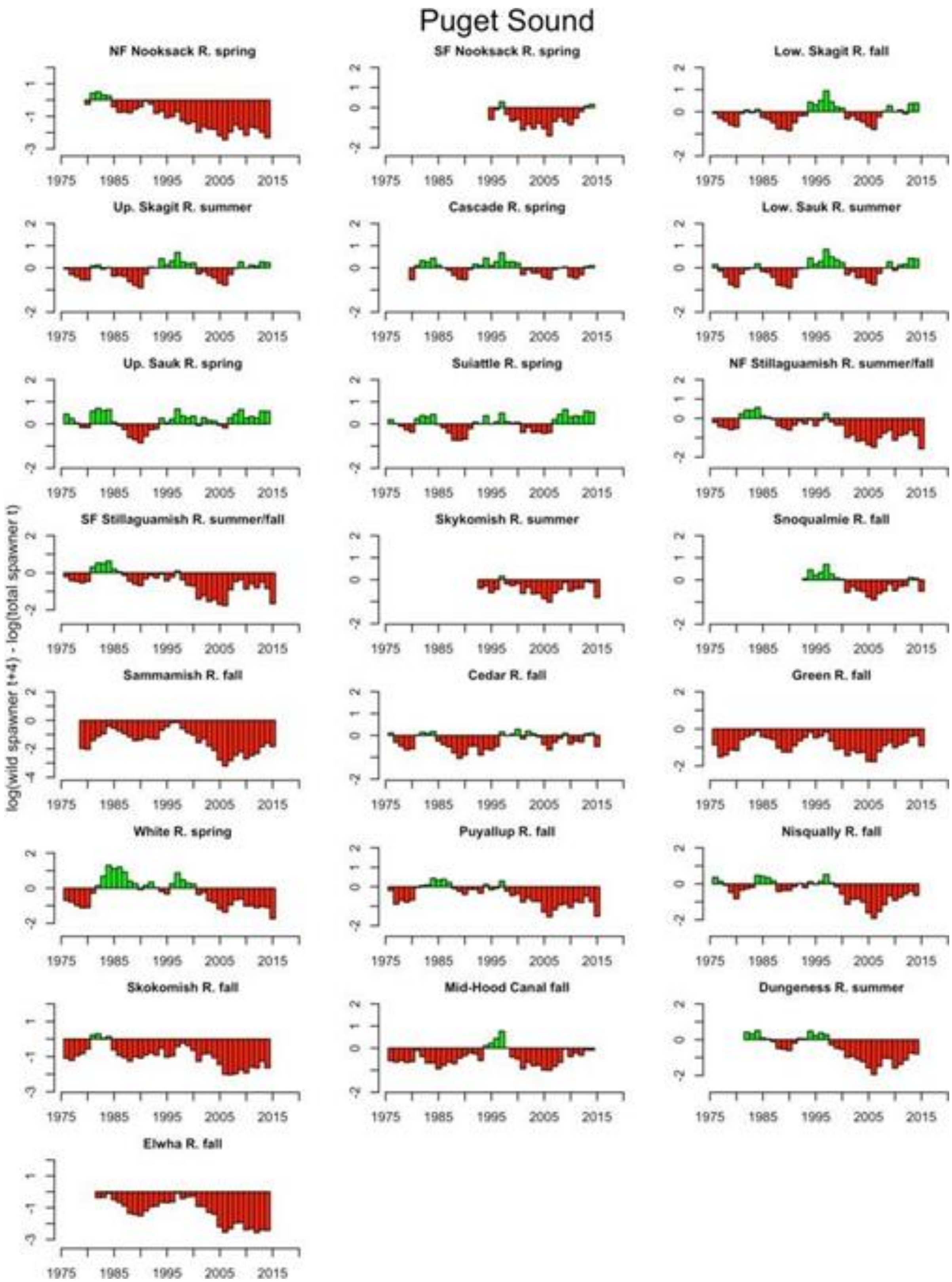

Figure 4. Trends in population productivity, estimated as the log of the smoothed natural-origin Chinook spawning abundance in year t – smoothed natural-origin spawning abundance in year (t – 4) (Ford 2022).

Limiting Factors. Limiting factors for this species include:

- Degraded floodplain and in-river channel structure
- Degraded estuarine conditions and loss of estuarine habitat
- Riparian area degradation and loss of in-river large woody debris
- Excessive fine-grained sediment in spawning gravel
- Degraded water quality and temperature
- Degraded nearshore conditions
- Impaired passage for migrating fish
- Altered flow regime

PS Chinook Salmon Recovery

Productive shoreline habitats of Puget Sound are necessary for the recovery of Puget Sound salmon (SSPS 2007). Nearshore areas serve as the nursery for juvenile PS Chinook salmon. Riparian vegetation, shade and insect production, and forage fish eggs along marine shorelines and river deltas help to provide food, cover and thermoregulation in shallow water habitats. Forage fish spawn in large aggregations along shorelines with suitable habitat, which produce prey for juvenile PS Chinook salmon. Juvenile salmon commonly occupy "pocket estuaries" where freshwater inputs provide salinity gradients that make adjusting to the marine environment less physiologically demanding. Pocket estuaries also provide refugia from predators. As the juvenile salmon grow and adjust, they move out to more exposed shorelines such as eelgrass, kelp beds and rocky shorelines where they continue to grow and migrate into the ocean environment.

The Puget Sound Recovery Plan (Volumes 1 and 2) includes specific recovery actions for each of the 22 extant populations of PS Chinook salmon. General protection and restoration actions summarized from the plan include:

- Counties should pass strong regulations and policies limiting shoreline armoring of these shorelines and offering incentives for protection;
- Aggressively protect areas, especially shallow water/low gradient habitats and pocket estuaries, within 5 miles of river deltas;
- Protect the forage fish spawning areas;
- Conduct limited beach nourishment on a periodic basis to mimic the natural sediment transport processes in select sections where corridor functions may be impaired by extensive armoring;
- Maintain the functioning of shallow, fine substrate features in and near 11 natal estuaries for Chinook salmon (to support rearing of fry);
- Maintain migratory corridors along the shores of Puget Sound;
- Maintain the production of food resources for salmon;
- Maintain functioning nearshore ecosystem processes (i.e., sediment delivery and transport; tidal circulation) that create and support the above habitat features and functions;
- Increase the function and capacity of nearshore and marine habitats to support key needs of salmon;
- Protect and restore shallow, low velocity, fine substrate habitats along marine shorelines, including eelgrass beds and pocket estuaries, especially adjacent to major river deltas;

- Protect and restore riparian areas;
- Protect and restore estuarine habitats of major river mouths;
- Protect and restore spawning areas and critical rearing and migration habitats for forage fish;

Development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of marine habitat for PS Chinook salmon. Projected changes in nearshore and estuary development based on documented rates of developed land cover change in Bartz et al. (2015) show that between 2008 and 2060, an additional 14.7 hectares of development of shoreline areas and 204 hectares of estuary development can be expected.

Chinook Use of Estuaries

Estuarine residence which allows growth, predator avoidance and smoltification is important to each of the six Skagit Chinook populations, and each function is facilitated by tidal dispersion. Numerous studies have characterized juvenile salmonid rearing within estuarine habitat, ranging from time of arrival and emigration, length of residence, dietary analysis and growth rates, and use of particular habitat types. Among all salmonid species, juvenile Chinook within estuaries is most obligate. Chinook, particularly ocean-type fish, take longer to adjust to increasing saline gradients, and rear and grow in estuaries greater relative to all other salmonid species (Thorpe 1994).

Timing of Arrival and Growth

Juvenile Chinook utilize estuarine habitats for foraging and physiological transition zones from fresh to saltwater environments. The timing and age class of Chinook emigration to estuarine habitats can be widely varied. Some Chinook juveniles, typically stream-type fish, will rear within freshwater habitat for several months to over a year, prior to emigration to estuaries. Ocean-type Chinook typically emigrate to the estuary within days or weeks after emergence as fry. The timing of emigration to estuarine habitats is likely a combination of genetically determined life-history expression, as well as environmentally determined factors, such as freshwater temperatures and discharge levels (Groot and Margolis 1991). Within the Skagit Basin, most juvenile Chinook salmon arrive from February through July (Beamer et al., 2000).

Within estuarine habitats juvenile Chinook salmon distribution is tidally dependent, residence time is widely varied, and differs among ocean and stream-type juveniles. Ocean-type fish reside in estuarine habitats for longer periods of time, typically arriving as early as February, with fish residing through July. Stream-type Chinook typically leave fresh water habitat the second spring post-emergence, and generally utilize estuarine habitats from days to weeks as they emigrate to the Puget Sound. Residence time and feeding within estuaries for stream-type Chinook is less obligate relative to ocean-type fish because they arrive at the estuary at larger sizes than ocean-type fish (Groot and Margolis 1991), and are able to exploit larger prey that are present in Puget Sound and the ocean. Conversely, ocean-type Chinook arrive within the estuary at smaller sizes, and rely on smaller food sources available within estuarine habitat prior to emigration to Puget Sound and the ocean.

When high numbers of juvenile Chinook occupy estuaries, growth within these populations can be slowed and reduced (Reimers 1973; Beamer et al. 2005). Within the Nanaimo River estuary, recovery of marked fry suggested a maximum residence of around 60 days (Groot and Margolis 1991). Juvenile Chinook salmon in the Skagit Basin have been documented to reside in the estuary from an average of 28 to 51 days (Beamer and Larsen 2004). However, fry migrants do not migrate directly to the estuary and instead emigrate directly to distributary channels, and nearshore habitats of Skagit Bay (Beamer and Larsen 2004).

Juvenile Chinook utilize a wide variety of food sources, often varying on the size of the fish. Documented food sources include zooplankton, terrestrial and aquatic insects, and other fish (Groot and Margolis 1991). Larger smolts (typically yearlings) are able to feed upon larger prey, such as chum or pink salmon fry, or other juvenile fish typically found in estuaries such as herring and sticklebacks. Chinook fry less than 50 millimeters (mm) long have diets dominated by benthic detritivores, herbivorous zooplankton and terrestrial insects (Northcote et al. 1979). One study reported juvenile Chinook diets consisting of 40 percent insects, 40 percent benthic organisms, and 20 percent plankton, and larger fish were observed to exploit more diverse diets that also included juvenile fish (Healey 1982).

Estuarine habitats provide rich feeding areas for smaller fry, and observed growth has been documented to be relatively rapid. Studies have reported daily length increases ranging from 0.44 mm (Columbia River estuary) and 0.48 mm in the Sacramento River estuary, to 0.33 mm (Cowichan River estuary), among others (Groot and Margolis 1991). Seasonal variation of growth has been observed as well. Within the Sixes River (Oregon), Reimers (1973) reported that estuarine growth from late April to early June was relatively rapid, ranging from 48 mm to 79 mm (0.9 mm/day), compared to June to August, in which fish length increased by 6mm, or (0.07 mm/d). The rate of growth among juvenile Chinook in the Nanaimo River (Canada) estuary averaged 1.32 mm/day, while the average length data from the general population was 0.5 mm/day (Healey 1980). Juvenile Chinook within the Nitinat River estuary grew 0.62 mm/day (Fedorenko et al., 1979).

Juvenile Chinook in the tidal marshes of the Skagit estuary were documented to be four to seven mm larger than their river cohorts, except during periods of high immigration, likely due to greater growth within the estuary (Congleton et al. 1981). Habitat within the Skagit River estuary, and other Puget Sound estuaries, has been differentiated by salinity and vegetation characteristics (Hayman et al. 1996; Haas and Collins 2001). Within the Skagit River estuary, growth within the estuarine emergent marsh (estuarine emergent marsh) habitat averaged 1.68 mm/day, which was over 3 times measured growth in emergent forested transition (ERT) zones, and forested riverine tidal (FRT) zones, which are upstream from estuarine emergent marsh habitat (SRSC and USGS 1999).

Within the Nanaimo River, reduced food intake and growth has been observed during periods of peak abundance of juveniles in the estuary (Groot and Margolis 1991). Stomach contents of fry averaged 2-5 percent of body weight, except during the period of peak fry abundance, when it was reduced to 0.5 percent of body weight (Groot and Margolis 1991). Similarly, average length of juveniles decreases with increased abundance of Chinook juveniles in the Skagit estuary (Beamer et. al. 2003).

Predation Avoidance

Chinook residence in estuaries is thought to provide a measure of protection from predators, such as birds, fish, otters and seals (Simenstad et al. 1982; Macdonald and Levings 1988; Thorpe 1994), though there are few comprehensive studies that analyze this. McCabe et al. (1986) documented very little predation on salmonids from other fish that reside in the Columbia River estuary. Non-salmonids that reside in estuaries are generally smaller than those in the intertidal region of the adjacent marine habitat (McCabe et al. 1986). Estuarine turbidity could be a mechanism that protects juvenile Chinook salmon from predation (Quinn 2005). The Skagit River has several large glaciers that seasonally cause turbid river and estuarine conditions. Tides and wave action can also suspend sediment, all of which may make juvenile Chinook salmon more difficult locate by predators. Perhaps most importantly, estuaries enable growth of juveniles, which are then less vulnerable from predation when they enter the sea.

Smoltification

Smoltification is an energetically demanding and complex change of morphology, physiology, and behavior designed to prepare juvenile salmonids for the vastly different environmental conditions in seawater (Quinn 2005). During this process, fish appearance changes as vertical parr marks fade to blue-green and silver sides, and their bellies turn white. These colors reduce vulnerability to predation in open water because fish are less apparent to predators from the side, above and below (Quinn 2005). The body also becomes more streamlined, and teeth further mature on the gums and tongue that allow fish to catch larger, faster, and a more diverse array of prey (Quinn 2005). Physiological changes include altered osmoregulation (salt balance) system, energy storage and kidney function and ion regulation though the gills. Behavioral changes include altered schooling, predator avoidance and feeding.

Tidal Distribution

Growth, predation avoidance and smoltification are enabled, in part, through tidal dispersion. Levy and Northcote (1981) investigated the relationship between occurrence and abundance of Chinook in estuarine habitats based on the physical characteristics of the habitat. Their findings established that juvenile Chinook prefer tidal channels with low banks and subtidal refugia, such as aquatic vegetation, and complex woody materials. Juvenile Chinook in estuaries often distribute with high tides, occupying temporarily inundated mudflats and marshes, and as tides recede, retreat into defined tidal channels that retain water at low tides (Groot and Margolis 1991). Juvenile Chinook are among the last fish to vacate tidal channels in the marsh when the channels dried up at low tide (Levy and Northcote 1981, 1982). Fish often concentrate in tidal channels at low tide, and move to the landward margin of the intertidal area on incoming and high tides (Healey 1980). During high tides, Chinook have been observed to vacate deeper intertidal habitat and preferred temporarily inundated habitat (Healey 1980). This distribution with the tidal cycle is likely a combination of passive movement with the current, and active selection of preferred habitat. Tide-dependent distribution facilitates dispersion into habitats that, by definition, are only available for portions of the day. Tidal dispersion is vital for juvenile Chinook because:

1. it provides access within small channels that provides cover from predators in the form of structural complexity from emergent vegetation, and general benthic structure (Miller and Simenstad 1997; McMahon and Holtby 1992);
2. it provides access to a greater volume of habitat for feeding opportunities, and simultaneously reduces juvenile Chinook density, and thus cohort competition for food. (Miller and Simenstad 1997; Neilson et al., 1985), and;
3. it provides access to habitats with slower current velocities relative to larger channels. Slower current velocities reduce energy expenditure used to maintain preferred water prism position, thus facilitating greater ability to pursue food. Stomach contents of salmon fry within the Skagit estuary peaked 3 to 4 hours after high tide, and minimum weights occurred late in the slack (ebb) water period (Congleton 1978). Juvenile salmon have been documented to have higher feeding rates at lower water velocities (Bailey et al., 1975).

Skagit Estuarine Habitat Related to VSP Parameters

Estuarine and Skagit Bay habitat provide vital functions that support Skagit Chinook abundance (both in terms of habitat capacity to juveniles and influencing the amount of adult returns), productivity, diversity (expressed here in terms of timing of arrival and duration of habitat use), and spatial structure.

Estuarine Abundance. Within the past decade, outmigrant abundance (juveniles that emerge from redds and travel downstream) has ranged from approximately 0.5 million to 6.5 million fish (Seiler et al., 2004). Vast habitat loss within the Skagit estuary constrains the amount of juvenile Chinook that can successfully reside and grow there. Within an average outmigrant class of 5.1 million juvenile Chinook, there is only enough rearing habitat in the estuary to host approximately 2,249,581 fish (44 percent) at optimum growth levels (Beamer et al., 2005). Estuarine abundance is minimally influenced by hatchery Chinook releases[9]. The amount of time juvenile Chinook remain in estuarine habitat is inversely proportional to their likelihood of successfully returning as adult fish (Reimers 1973; Levings et al. 1989). Depending upon the outmigrant class size, average juvenile Chinook densities per acre of estuarine habitat ranges from 808 to 5,668 fish per acre during the outmigrant season (Beamer et al. 2005). The quantification of this density is important because fish that have the opportunity to rear in the estuary are larger (Beamer et al. 2005), and in turn have a demonstrated survival advantage over those fish that emigrate directly to Skagit Bay.

Estuarine Productivity. Productivity within the Skagit estuary has been reduced from habitat loss and degradation, and as a result juvenile growth is reduced in most years. Habitat in the Skagit estuary is delineated, from upstream to the Skagit Bay, into forested riverine tidal, estuarine forested transition, and estuarine emergent marsh. These delineations represent differing vegetative communities and saline gradients. Measurements of juvenile Chinook growth within these habitats reveals that estuarine emergent marsh is the most productive habitat within the estuary, the average growth rate for juvenile Chinook is estuarine emergent marsh was 1.68 millimeters per day (mm/d), compared to 0.53 (mm/d) within forested riverine tidal and

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[9] As an example, the 2003 Skagit River Chinook outmigrant class was 5.5 million fish, and 197,000 were also estimated to be hatchery releases, roughly equating to 3.6 percent of the outmigrant class size.

estuarine forested transition habitat (Beamer et al. 2005). Estuarine productivity is related to the amount of time juveniles spend within the estuary, the type of habitat they reside in within the estuary, and the numbers of individuals occupying its habitat, among other environmental factors such as abundance of food sources.

Estuarine Diversity. Habitat loss and degradation within the Skagit estuary likely constrains the diversity of the six Skagit Chinook populations. Within the Skagit River, several different life history subtypes have been identified to describe the variability in utilization patterns of riverine and estuarine habitats by young of the year juvenile Chinook salmon (Beamer and Larson 2004). These rearing subtypes, termed yearlings, tidal delta migrants, parr migrants, and fry migrants have been designated as a result of Skagit River Chinook otolith[10] collection and analysis (Beamer et al. 2005):

Yearling fish rear within freshwater for at least one year, and migrate to Skagit Bay from late March through May at an average size of 120 mm. Yearling fish do not reside in the Skagit estuary for extended periods, and move to deeper water habitats in Skagit Bay, and are rarely found in nearshore habitat.

Parr migrants grow in freshwater habitat to similar sizes as Tidal delta fish, within approximately two months. These fish migrate to Skagit Bay at an average size of 75 mm, and do not reside in tidal delta habitats for measurable periods.

Tidal delta migrants emerge and emigrate downstream concurrently with fry migrants, but reside in the estuary from several weeks to several months (average of 34.2 days in 1995 and 1996), reaching an average length of 74 mm before moving to Skagit Bay in May through June.

Fry migrants are fish that rapidly emigrate down the river after emergence. These fish do not rear for measurable periods within the estuary, and are typically the first juveniles to enter Skagit Bay (from February through March), with an average fork length of 39 mm. Chinook fry migrants are less fit to survive within saltwater relative to the other life-history types. Because of their rapid entry to higher saline environments, it is likely that fry migrants are unable to properly initiate or complete the important process of smoltification. It is very likely that most fry migrants would be tidal delta migrants, but the Skagit estuary is not large enough to accommodate all juveniles within most years.

All six Skagit Chinook populations have yearlings, parr migrants, tidal delta migrants, and fry migrant life history (Figure 5). Though this is a small data set, it is noteworthy that all populations appear to have relatively similar proportions of fry migrant juveniles, which are less fit (mostly because of their small size) to survive in Skagit Bay, Puget Sound and the Ocean. This diversity, spread out among the populations, enables these stocks to be more resilient to naturally changing habitat conditions. As an example, Yearlings would not be subjected to poor ocean conditions during their year of freshwater residency. Conversely, tidal delta users minimize their risk from poor freshwater conditions because they rely much more on estuarine

[10] Otoliths are calcareous particles found in the inner ear of vertebrates. Chinook movement and growth can be generally tracked, on a daily basis, upon removal and investigation of the otolith.

habitat prior to emigration to the ocean. They are also able to capitalize upon favorable ocean conditions sooner than Yearling fish.

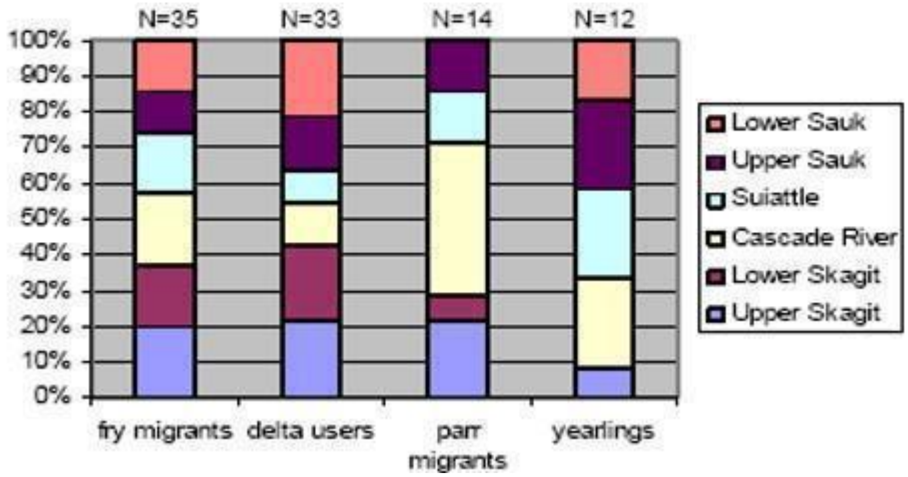

Figure 5. Proportion of Rearing Life History Types for Each Skagit Chinook Population. (Beamer et al. 2005).

Estuarine and Skagit Bay Spatial Structure. Within the Skagit estuary and Bay, juvenile Chinook habitat usage is largely dependent upon landscape and local (or site level) habitat connectivity. Landscape connectivity within the estuary, and in turn juvenile Chinook usage, is influenced by a number of natural and human induced habitat pathways and blockages. For instance, juvenile Chinook densities within the Swinomish Channel and Padilla Bay (located to the North of the Skagit estuary) are generally much lower than other portions of the estuary and bay. These low densities are very likely influenced by reduced connectivity caused by the Swinomish Channel Jetty, which directs river flow, and in turn juvenile Chinook, away from the channel and reduces northward migration opportunity (Yates 2001). Conversely, juvenile Chinook densities within the Skagit estuary itself is the highest, averaging 4,534 fish per hectare of blind channels[11] with high connectivity habitat over the outmigrant season (Beamer et al. 2005). Chinook densities with the Skagit estuary is also dependent upon local habitat characteristics; estuarine habitat use is influenced by current velocities, depths, and amount of edge habitat (Beamer et al. 2005); juvenile Chinook densities are the greatest in deep low velocity blind channels compared to other estuarine habitat.

[11] 'Blind Channels' are waterways that are formed by, and drain, tidally introduced water rather than runoff from associated wetlands and upland sources (Simenstad 1983).

Status of Puget Sound Steelhead

The PS steelhead DPS was listed as a threatened species under the ESA on May 11, 2007 (72 FR 26722) (Table 3). Subsequent status assessments of the DPS after the ESA-listing decision have found that the status of PS steelhead regarding risk of extinction has not changed substantially (Ford et al. 2011; NMFS 2017) (81 FR 33468, May 26, 2016) (Ford 2022). As mentioned above in the PS Chinook status review section, on October 4, 2019 NMFS published a Federal Register notice (84 FR 53117), announcing NMFS' intent to initiate a new 5-year status review for 28 listed species of Pacific salmon and steelhead and requesting updated information from the public to inform the most recent five-year status review. On March 24, 2020, NMFS extended the public comment period, from the original March 27, 2020, through May 26, 2020 (85 FR 16619).

As with Chinook salmon status information (above), the Northwest Fishery Science Center (NWFSC) completed the Viability Risk Assessment for steelhead (Ford 2022). NMFS' West coast Regional Office (WCRO) is currently preparing the final 5-year status review documents, with anticipated completion in 2024. In this section, where possible, particularly as new material becomes available, the latest final (2017) status review information is supplemented with more recent information and other population specific data that may not have been available during the 2017 status review, including some of the information in the draft 2024 status review, so that NMFS is assured of using the best available information for this opinion.

At the time of listing the Puget Sound steelhead Biological Review Team (BRT) considered the major risk factors associated with spatial structure and diversity of PS steelhead to be: (1) the low abundance of several summer run populations; (2) the sharply diminishing abundance of some winter steelhead populations, especially in south Puget Sound, Hood Canal, and the Strait of Juan de Fuca; and (3) continued releases of out-of-ESU hatchery fish from Skamania-derived summer run and Chambers Creek-derived winter run stocks (Hard et al. 2007; Hard et al. 2015). Loss of diversity and spatial structure were judged to be "moderate" risk factors (Hard et al. 2007). In 2011 the BRT identified degradation and fragmentation of freshwater habitat, with consequential effects on connectivity, as the primary limiting factors and threats facing the PS steelhead DPS (Ford et al. 2011). The BRT also determined that most of the steelhead populations within the DPS continued to show downward trends in estimated abundance, with a few sharp declines (Ford et al. 2011). The 2015 status review concurred that harvest and hatchery production of steelhead in Puget Sound were at low levels and not likely to increase substantially in the foreseeable future, thus these risks have been reduced since the time of listing (NWFSC 2015). However, unfavorable environmental trends previously identified (Ford et al. 2011) were expected to continue (Hard et al. 2015).

Spatial Structure and Diversity.
The PS steelhead DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations originating below natural and manmade impassable barriers from rivers flowing into Puget Sound from the Elwha River (inclusive) eastward, including rivers in Hood Canal, South Sound, North Sound and the Strait of Georgia. Non-anadromous ''resident'' *O. mykiss* occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard et al. 2007). In October

of 2016, NMFS proposed revisions to the hatchery programs included as part of Pacific salmon ESUs and steelhead DPSs listed under the ESA (81 FR 72759). NMFS issued its final rule in December of 2020 (85 FR 81822). This final rule includes steelhead from five artificial propagation programs in the PS steelhead DPS: the Green River Natural Program; White River Winter Steelhead Supplementation Program; Hood Canal Steelhead Supplementation Program; the Lower Elwha Fish Hatchery Wild Steelhead Recovery Program; and the Fish Restoration Facility Program. (85 FR 81822, December 17, 2020).

In 2013, the Puget Sound Steelhead Technical Review Team (PSSTRT) completed its evaluation of factors that influence the diversity and spatial structure VSP criteria for steelhead in the DPS. For spatial structure, this included the fraction of available intrinsic potential rearing and spawning habitat that is occupied compared to what is needed for viability[12]. For diversity, these factors included hatchery fish production, contribution of resident fish to anadromous fish production, and run timing of adult steelhead. Quantitative information on spatial structure and connectivity was not available for most PS steelhead populations, so a Bayesian Network framework was used to assess the influence of these factors on steelhead viability at the population, MPG, and DPS scales (Hard et al. 2015). The PSSTRT concluded that low population viability was widespread throughout the DPS and populations showed evidence of diminished spatial structure and diversity. Specifically, population viability associated with spatial structure and diversity was highest in the Northern Cascades MPG and lowest in the Central and South Puget Sound MPG (PSSTRT 2013). Diversity was generally higher for populations within the Northern Cascades MPG, where more variability in viability was expressed and diversity generally higher, compared to populations in both the Central and South Puget Sound and Hood Canal and Strait of Juan de Fuca MPG, where diversity was depressed and viabilities were generally lower (NWFSC 2015). Most PS steelhead populations were given intermediate scores for spatial structure and low scores for diversity because of extensive hatchery influence, low breeding population sizes, and freshwater habitat fragmentation or loss (NWFSC 2015). The PSSTRT concluded that the Puget Sound DPS was at very low viability, considering the status of all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). For spatial structure there were a number of events that occurred in Puget Sound during the last review period (2015-2019) that are anticipated to improve status populations within several of the MPGs within the DPS (Ford 2022).

Since the PSSTRT completed its 2013 review, the only additional spatial structure and diversity data that have become available have been estimates of the fraction of hatchery fish on the spawning grounds (NWFSC 2015, Ford 2022). Since publication of the NWFSC report in 2015, and drafting of the NWFSC biological viability risk assessment (Ford 2022), reductions in hatchery programs founded from non-listed and out of DPS stocks (i.e., Skamania) have occurred. In addition, the fraction of out of DPS hatchery steelhead spawning naturally are low for many rivers (NWFSC 2015). The fraction of natural-origin steelhead spawners was 0.9 or greater for the 2005-2009 and 2010-2014 time periods for all populations where data was available, but the Snoqualmie and Stillaguamish rivers (NMFS 2016a). For 17 of 22 DIPs across the DPS, the five-year average for the fraction of natural-origin steelhead spawners exceeded 0.75 from 2005 to 2009; this average was near 1.0 for 8 populations, where data were available,

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[12] Where intrinsic potential is the area of habitat suitable for steelhead rearing and spawning, at least under historical conditions (PSSTRT 2013).

from 2010 to 2014 (NWFSC 2015). However, the fraction of natural-origin steelhead spawners could not be estimated for a substantial number of DIPs during the 2010 to 2014 period, or for the most recent 2015 – 2019 timeframe (NWFSC 2015; Ford 2022). In some river systems, such as the Green River, Snohomish/Skykomish Rivers, and the Stillaguamish rivers these estimates were higher than some guidelines recommend (e.g., no more than 5 percent hatchery-origin spawners on spawning grounds for isolated hatchery programs (HSRG 2009) over the 2005-2009 and 2010-2014 timeframes. The NWFSC biological viability risk assessment (Ford 2022) states that a third of the 32 PS steelhead populations continue to lack monitoring and abundance data, and in most cases, it is likely that abundances are very low.

Early winter-run fish produced in isolated hatchery programs are derived from Chambers Creek stock in southern Puget Sound, which has been selected for early spawn timing, a trait known to be inheritable in salmonids.[13] Summer-run fish produced in isolated hatchery programs were historically derived from the Skamania River summer stock in the lower Columbia River Basin (i.e., from outside the DPS). The production and release of hatchery fish of both run types (winter and summer) may continue to pose risk to diversity in natural-origin steelhead in the DPS, as described in Hard et al. (2007) and Hard et al. (2015). However, the NWFSC biological viability risk assessment (Ford 2022) states that risks to natural-origin PS steelhead that may be attributable to hatchery-related effects has decreased since the 2015 status review due to reductions in production of non-listed stocks, and the replacement with localized stocks. The three summer steelhead programs continuing to propagate Skamania derived stocks from outside of Puget Sound should be phased out completely by 2031 (NMFS 2019; Ford 2022).

Abundance and Productivity.
The viability of the PS steelhead DPS has improved somewhat since the PSSTRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Increases in spawner abundance have been observed in a number of populations over the last five years; however, these improvements were disproportionately found within the South and Central Puget Sound and Strait of Juan de Fuca and Hood Canal MPGs, and primarily among smaller populations. The recent positive trends among winter-run populations in the White, Nisqually, and Skokomish rivers improve the demographic risks facing those populations. The abundance, productivity, spatial structure, and diversity of Elwha River steelhead winter and summer-runs has dramatically improved following the removal of the Elwha River dams. Improvements in abundance have not been as widely observed in the Northern Puget Sound MPG. The declines of summer and winter-run populations in the Snohomish Basin are especially concerning. These populations figure prominently as sources of abundance for the MPG and DPS (NMFS 2019). Additionally, the decline in the Tolt River summer-run steelhead population was especially alarming given that it is the only summer-run population for which we have long-term abundance estimates. The demographic and diversity risks to the Tolt River summer-run DIP are very high. In fact, all summer-run steelhead populations in the North Cascades MPG are likely at a very high demographic risk. In spite of improvements in some areas (i.e., Elwha River population following dam removal), most populations are still at relatively low abundance levels, with about a third of the DIPs unmonitored and presumably at very low levels (Table 5) (Ford 2022).

[13] The native Chambers Creek steelhead population is now extinct.

The PSSTRT was reconvened by NOAA Fisheries and convened in March 2014 to develop a Recovery Plan for the PS steelhead DPS. This Recovery Plan was finalized in December 2019 (NMFS 2019). Recovery targets were calculated using a two-tiered approach adjusting for years of low and high productivity. Abundance information is unavailable for approximately one-third of the DIPs, disproportionately so for summer-run populations. In most cases where no information is available it is assumed that abundances are very low. Some population abundance estimates are only representative of part of the population (index reaches, etc.). Where recent five-year abundance information is available, 30 percent (6 of 20 populations) are less than 10 percent of their high productivity recovery targets (lower abundance target), 65 percent (13 of 20) are between 10 and 50 percent, and 5 percent (1 of 20) are greater than 50 percent of their low abundance targets (Table 5). A key element to achieving recovery is recovering a representative number of both winter- and summer-run steelhead populations, and the restoration of viable summer-run DIPs is a long-term endeavor (NMFS 2019). Fortunately, the relatively rapid reestablishment of summer-run steelhead in the Elwha River does provide a model for potentially re-anadromizing summer-run steelhead sequestered behind impassable dams.

Table 5. Recent (2015-2019) 5-year geometric mean of raw wild spawner counts for Puget Sound steelhead populations and population groups compared with Puget Sound Steelhead Recovery Plan high and low productivity recovery targets (NMFS 2019). (SR) – Summer-run. Abundance is compared to the high productivity individual DIP targets. Colors indicate the relative proportion of the recovery target currently obtained: red (<10 percent), orange (10 percent>x<50 percent), yellow (50 percent>x<100 percent), green (>100 percent). "*" denotes an interim recovery target.

Major Population Group	Demographically Independent Population	Recent Abundance (2015-2019)	Recovery Target	
			High Productivity	Low Productivity
Northern Cascades	Drayton Harbor Tributaries	N/A	1,100	3,700
	Nooksack River	1,906	6,500	21,700
	South Fork Nooksack River (SR)	N/A	400	1,300
	Samish River & Independent Tributaries	1,305	1,800	6,100
	Skagit River	7,181	15,000 *	
	Sauk River	N/A		
	Nookachamps River	N/A		
	Baker River	N/A		
	Stillaguamish River	487	7,000	23,400

Major Population Group	Demographically Independent Population	Recent Abundance (2015-2019)	Recovery Target	
			High Productivity	Low Productivity
	Canyon Creek (SR)	N/A	100	400
	Deer Creek (SR)	N/A	700	2,300
	Snohomish/Skykomish River	690	6,100	20,600
	Pilchuck River	638	2,500	8,200
	Snoqualmie River	500	3,400	11,400
	Tolt River (SR)	40	300	1,200
	North Fork Skykomish River (SR)	N/A	200	500
Central and South Sound	Cedar River	N/A	1,200	4,000
	North Lake Washington Tributaries	N/A	4,800	16,000
	Green River	1,282	5,600	18,700
	Puyallup/Carbon River	136	4,500	15,100
	White River	130	3,600	12,000
	Nisqually River	1,368	6,100	20,500
	East Kitsap Tributaries	N/A	2,600	8,700
	South Sound Tributaries	N/A	6,300	21,200
Strait of Juan de Fuca	Elwha River	1,241	2,619	
	Dungeness River	408	1,200	4,100
	Strait of Juan de Fuca Independent Tributaries	95	1,000	3,300
	Sequim and Discovery Bay Tributaries	N/A	500	1,700
	Skokomish River	958	2,200	7,300
	West Hood Canal Tributaries	150	2,500	8,400

Major Population Group	Demographically Independent Population	Recent Abundance (2015-2019)	Recovery Target	
			High Productivity	Low Productivity
	East Hood Canal Tributaries	93	1,800	6,200
	South Hook Canal Tributaries	91	2,100	7,100

There are a number of planned, ongoing, and completed actions that will likely benefit steelhead populations in the near term, but have not yet influenced adult abundance. Among these, the removal of the diversion dam on the Middle Fork Nooksack River, the Pilchuck Dam removal, passage improvements at Mud Mountain Dam, the ongoing passage program in the North Fork Skokomish River, and the planned passage program at Howard Hanson Dam. Additionally, fish passage above three dams on the Skagit River are currently under consideration (Seattle City Light 2023). Dam removal in the Elwha River, and the resurgence of the endemic winter and summer-run steelhead populations have underscored the benefits of restoring fish passage. The Elwha River scenario is somewhat unique in that upstream habitat is in pristine condition and smolts emigrate into the Strait of Juan de Fuca and not Puget Sound or Hood Canal.

Improvements in spatial structure can only be effective if done in concert with necessary improvements in habitat. Habitat restoration efforts are ongoing, but land development and habitat degradation concurrent with increasing human population in the Puget Sound corridor results in a continuing net loss of habitat. Recovery efforts in conjunction with improved ocean and climatic conditions have resulted in improved viability status for the majority of populations in this DPS; however, absolute abundances are still low, especially summer-run populations, and the DPS remains at high to moderate risk of extinction. However, since 2015, fifteen of the 21 populations indicate small to substantive increases in abundance, although most steelhead populations remain small. From 2015 to 2019, nine of the 21 steelhead populations had fewer than 250 natural spawners annually, and 12 of the 21 steelhead populations had 500 or fewer natural-origin spawners (Table 6).

Table 6. Five-year geometric mean of raw natural spawner counts for PS steelhead. In parentheses, the 5-year geometric mean of raw total spawner counts is shown. Percent change between the most recent two 5-year periods is shown on the far-right column (Ford 2022).

Biogeographic Region	Population	2010-2014	2015-2019	Population trend (% Change)
North Cascades	Samish R. / Bellingham Bay Tribs. (W)	748	1305	Positive (74)
	Nooksack R. (W)	1745	1906	Positive (9)
	Skagit R. (S and W)	6391	7181	Positive (12)
	Stillaguamish R. (W)	386	487	Positive (26)
	Snohomish/ Skykomish R. (W)	975	690	Negative (-29)
	Pilchuck R. (W)	626	638	Positive (2)
	Snoqualmie R. (W)	706	500	Negative (-29)
	Tolt R. (S)	108	40	Negative (-63)
Central/South Puget Sound Basin	N. Lake WA Tribs. (W)	-	-	-
	Cedar R. (W)	4	6	Positive (50)
	Green R. (W)	662	1289	Positive (95)
	White R. (W)	514	451	Negative (-12)
	Puyallup R. (W)	85	201	Positive (136)
	Carbon R. (W)	(290)	(735)	Positive (153)
	Nisqually R. (W)	477	1368	Positive (187)
Hood Canal/Strait of Juan de Fuca	S. Hood Canal (W)	69	91	Positive (32)
	Eastside Hood Canal Tribs (W)	60	93	Positive (55)
	Skokomish R. (W)	533	958	Positive (80)
	Westside Hood Canal Tribs (W)	138	150	Positive (9)

Biogeographic Region	Population	2010-2014	2015-2019	Population trend (% Change)
	Dungeness R. (S and W)	517	448	Negative (-13)
	Strait of Juan de Fuca Independents (W)	151	95	Negative (-37)
	Elwha R. (W)	680	1241	Positive (82)

Limiting Factors. In our 2013 proposed rule designating critical habitat for this species (78 FR 2725), we noted that the following factors for decline for PS steelhead persist as limiting factors:

- The continued destruction and modification of steelhead habitat.
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years.
- Threats to diversity posed by use of progeny from two hatchery steelhead stocks (Chambers Creek and Skamania).
- Declining diversity in the DPS, including the uncertain but weak status of summer run fish.
- A reduction in spatial structure.
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris.
- In the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, increased flood frequency and peak flows during storms and reduced groundwater-driven summer flows, with resultant gravel scour, bank erosion, and sediment deposition.
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, increasing the likelihood of gravel scour and dislocation of rearing juveniles.

PS Steelhead Recovery.
The PS steelhead recovery plan provides guidance to recover the species to the point that it can be naturally self-sustaining over the long term. To achieve full recovery, steelhead populations in Puget Sound need to be robust enough to withstand natural environmental variation and some catastrophic events, and they should be resilient enough to support harvest and habitat loss due to human population growth. The Plan aims to improve steelhead viability by addressing the pressures that contribute to the current condition: habitat loss/degradation, water withdrawals, declining water quality, fish passage barriers, dam operations, harvest, hatcheries, climate change effects, and reduced early marine survival. NMFS is using the recovery plan to organize and coordinate recovery of the species in partnership with state, local, tribal, and federal resource managers, and the many watershed restoration partners in the Puget Sound. Consultations, including this one, will incorporate information from the Plan (NMFS 2019).

Juvenile PS steelhead are less dependent on nearshore habitats for early marine rearing than Chinook or Chum Salmon; nevertheless, nearshore, estuarine, and shoreline habitats provide important features necessary for the recovery of steelhead. PS steelhead spend only a few days to a few weeks migrating through the large fjord, but mortality rates during this life stage are critically high (Moore et al. 2010; Moore and Berejikian 2017). Early marine mortality of PS steelhead is recognized as a primary limitation to the species' survival and recovery (NMFS 2019). Factors in the marine environment influencing steelhead survival include predation, access to prey (primarily forage fish), contaminants (toxics), disease and parasites, migration obstructions (e.g., the Hood Canal bridge), and degraded habitat conditions which exacerbate these factors (NMFS 2019).

The PS steelhead recovery plan identifies ten ecological concerns that directly impact salmon and steelhead:

- Habitat quantity (anthropogenic barriers, natural barriers, competition);
- Injury and mortality (predation, pathogens, mechanical injury, contaminated food);
- Food (altered primary productivity, food-competition, altered prey species composition and diversity);
- Riparian condition (riparian condition, large wood recruitment);
- Peripheral and transitional habitats (side channel and wetland condition, estuary conditions, nearshore conditions);
- Channel structure and form (bed and channel form, instream structural complexity);
- Sediment conditions (decreased sediment quantity, increased sediment quantity);
- Water quality (temperature, oxygen, gas saturation, turbidity, pH, salinity, toxic contaminants);
- Water quantity (increased water quality, decreased water quality, altered flow timing); and
- Population-level effects (reduced genetic adaptiveness, small population effects, demographic changes, life history changes).

The Puget Sound steelhead recovery plan and its associated appendix 3 includes specific recovery actions for the marine environment. General protection and restoration actions summarized from the plan include:

- Continue to improve the assessments of harbor seal predation rates on juvenile steelhead;
- Remove docks and floats which act as artificial haul-out sites for seals and sea lions;
- Consistent with the MMPA, test acoustic deterrents and other hazing techniques to reduce steelhead predation from harbor seals;
- Develop non-lethal actions for "problem animals and locations" to deter predation;
- Increase forage fish habitat to increase abundance of steelhead prey;
- Remove bulkheads and other shoreline armoring to increase forage fish;
- Acquire important forage fish habitat to protect high forage fish production areas;
- Add beach wrack to increase forage fish egg survival;
- Protect and restore aquatic vegetation (e.g., eelgrass and kelp);
- Remove creosote pilings to reduce mortality of herring eggs;
- Increase the assessment of migratory blockages, especially the Hood Canal bridge, where

differential mortality has been documented;
- Identify and remedy sources of watershed chemical contaminants (e.g., PBDEs and PCBs).

In the recovery plan, NMFS and the PSSTRT modified the 2013 and 2015 PSSTRT viability criteria to produce the viability criteria for PS steelhead, as described below:

- All three MPGs (North Cascade, Central-South Puget Sound, and Hood Canal-Strait of Juan de Fuca) must be viable (Hard et al. 2015). The three MPGs differ substantially in key biological and habitat characteristics that contribute in distinct ways to the overall viability, diversity, and spatial structure of the DPS.
- There must be sufficient data available for NMFS to determine that each MPG is viable.

The recovery plan also established MPG-level viability criteria. The following are specific criteria are required for MPG viability:

- At least 50 percent of steelhead populations in the MPG achieve viability.
- Natural production of steelhead from tributaries to Puget Sound that are not identified in any of the 32 identified populations provides sufficient ecological diversity and productivity to support DPS-wide recovery.
- In addition to the minimum number of viable DIPs (50 percent) required above, all DIPs in the MPG must achieve an average MPG-level viability that is equivalent to or greater than the geometric mean (averaged over all the DIPs in the MPG) viability score of at least 2.2 using the 1–3 scale for individual DIPs described under the DIP viability discussion in the PSSTRT Viability Criteria document (Hard et al. 2015). This criterion is intended to ensure that MPG viability is not measured (and achieved) solely by the strongest DIPs, but also by other populations that are sufficiently healthy to achieve MPG-wide resilience. The Plan allows for an alternative evaluation method to that in Hard et al. (2015) may be developed and used to assess MPG viability.
- The plan also identified specific DIPs in each of the three MPGs which must attain viability NMFS 2019).

The Plan (NMFS 2019) also identified specific DIPs in each of the three MPGs which must attain viability. These DIPs, by MPG, are described as follows:

For the **North Cascades MPG**, eight of the sixteen DIPs in the North Cascades MPG must be viable. The eight (five winter-run and three summer-run) DIPs described below must be viable to meet this criterion:

- Of the eleven DIPs with winter or winter/summer runs, five must be viable:
- Nooksack River Winter-Run;
- Stillaguamish River Winter-Run;
- One from the Skagit River (either the Skagit River Summer-Run and Winter-Run or the Sauk River Summer-Run and Winter-Run);
- One from the Snohomish River watershed (Pilchuck, Snoqualmie, or Snohomish/Skykomish River Winter-Run); and
- One other winter or summer/winter run from the MPG at large.

The rationale for this is that there are four major watersheds in this MPG, and one viable population from each will help attain geographic spread and habitat diversity within core extant steelhead habitat (NMFS 2019). Of the five summer-run DIPs in this MPG, three must be viable, representing each of the three major watersheds containing summer-run populations (Nooksack, Stillaguamish, Snohomish rivers). Therefore, the priority summer-run populations are as follows:

- South Fork Nooksack River Summer-Run;
- One DIP from the Stillaguamish River (Deer Creek Summer-Run or Canyon Creek Summer-Run); and
- One DIP from the Snohomish River (Tolt River Summer-Run or North Fork Skykomish River Summer-Run).

As described, these priority populations in the North Cascades MPG include specific, winter or winter/summer-run populations from the Nooksack, Stillaguamish, Skagit or Sauk, and Snohomish River basins and three summer-run populations from the Nooksack, Stillaguamish, and Snohomish basins. These populations are targeted to achieve viable status to support MPG viability. Having viable populations in these basins assures geographic spread, provides habitat diversity, reduces catastrophic risk, and increases life-history diversity (NMFS 2019).

For the **Central and South Puget Sound MPG**, four of the eight DIPs in the Central and South Puget Sound MPG must be viable. The four DIPs described below must be viable to meet this criterion:

- Green River Winter-Run;
- Nisqually River Winter-Run;
- Puyallup/Carbon rivers Winter-Run, or the White River Winter-Run; and
- At least one additional DIP from this MPG: Cedar River, North Lake Washington/Sammamish Tributaries, South Puget Sound Tributaries, or East Kitsap Peninsula Tributaries.

The rationale for this prioritization is that steelhead inhabiting the Green, Puyallup, and Nisqually River watersheds currently represent the core extant steelhead populations and these watersheds contain important diversity of stream habitats in the MPG.

For the **Hood Canal and Strait of Juan de Fuca MPG**, four of the eight DIPs in the Hood Canal and Strait of Juan de Fuca MPG must be viable. The four DIPs described below must be viable to meet this criterion:

- Elwha River Winter/Summer-Run (see rationale below);
- Skokomish River Winter-Run;
- One from the remaining Hood Canal populations: West Hood Canal Tributaries Winter-Run, East Hood Canal Tributaries Winter-Run, or South Hood Canal Tributaries Winter-Run; and
- One from the remaining Strait of Juan de Fuca populations: Dungeness Winter-Run, Strait of Juan de Fuca Tributaries Winter-Run, or Sequim/Discovery Bay Tributaries Winter-Run.

The rationale for this prioritization is that the Elwha and Skokomish rivers are the two largest single watersheds in the MPG and bracket the geographic extent of the MPG. Furthermore, both Elwha and Skokomish populations have recently exhibited summer-run life histories, although the Dungeness River population was the only summer/winter run in this MPG recognized by the PSSTRT in Hard et al. (2015). Two additional populations, one population from the Strait of Juan de Fuca area and one population from the Hood Canal area, are needed for a viable MPG to maximize geographic spread and habitat diversity.

Lastly, the Plan (NMFS 2019) also identified additional attributes, or characteristics which should be associated with a viable MPG:

- All major diversity and spatial structure conditions are represented, based on the following considerations:
- Populations are distributed geographically throughout each MPG to reduce risk of catastrophic extirpation; and
- Diverse habitat types are present within each MPG (one example is lower elevation/gradient watersheds characterized by a rain-dominated hydrograph and higher elevation/gradient watersheds characterized by a snow-influenced hydrograph).

Federal and state steelhead recovery and management efforts will provide new tools and data and technical analyses to further refine PS steelhead population structure and viability, if needed, and better define the role of individual populations at the watershed level and in the DPS. Future consultations will incorporate information from the Plan (NMFS 2019).

Status of Southern Resident Killer Whales (SRKWs)

The SRKW DPS, composed of J, K, and L pods, was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). A 5-year review under the ESA completed in 2021 concluded that SRKWs should remain listed as endangered and includes recent information on the population, threats, and new research results and publications (NMFS 2022b).

The NMFS considers SRKWs to be currently among nine of the most at-risk species as part of the Species in the Spotlight initiative because of their endangered status, declining population trend, and because they are high priority for recovery based on conflict with human activities and recovery programs in place to address threats. The population has relatively high mortality and low reproduction unlike other resident killer whale populations that have generally been increasing since the 1970s (Carretta et al. 2020).

The limiting factors described in the final recovery plan included reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS 2008). This section summarizes the status of SRKWs throughout their range and summarizes information taken largely from the recovery plan (NMFS 2008), most recent 5-year review (NMFS 2016b), the Pacific Fishery Management Council (PFMC) SRKW Ad Hoc Workgroup’s report (PFMC 2020), as well as newly available data.

Abundance and Productivity.
Killer whales—including SRKWs—are a long-lived species and sexual maturity can occur at age ten (NMFS (2008)). Females produce a low number of surviving calves (n < 10, but generally fewer) over the course of their reproductive life span (Bain 1990; Olesiuk et al. 1990). Compared to Northern Resident killer whales (NRKWs), which are a resident killer whale population with a sympatric geographic distribution ranging from coastal waters of Washington State and British Columbia north to Southeast Alaska, SRKW females appear to have reduced fecundity (Ward et al. 2013; Vélez-Espino et al. 2014), and all age classes of SRKWs have reduced survival compared to other fish-eating populations of killer whales in the Northeast Pacific (Ward et al. 2013).

Since the early 1970s, annual summer censuses in the Salish Sea using photo-identification techniques have occurred (Olesiuk et al. 1990; Center for Whale Research 2019). The population of SRKW was at its lowest known abundance in the early 1970s following live-captures for aquaria display (n = 68). The highest recorded abundance since the 1970s was in 1995 (98 animals), though the population declined from 1995-2001 (from 98 whales in 1995 to 81 whales in 2001). The population experienced a growth between 2001 and 2006 and has been generally declining since then. However, in 2014 and 2015, the SRKW population increased from 78 to 81 as a result of multiple successful pregnancies (n = 9) that occurred in 2013 and 2014. At present, the SRKW population has declined to near historically low levels. As of March 2024, the population is 74 whales, including 25 whales in J pod, 16 whales in K pod, and 34 whales in L pod, including two calves born to J pod in September 2020 and one new calf to the L pod in February 2021 (Center for Whale Research 2024). The previously published historical estimated abundance of SRKW is 140 animals (NMFS 2008). This estimate (~140) was generated as the number of whales killed or removed for public display in the 1960s and 1970s (summed over all years) added to the remaining population at the time the captures ended.

Based on an updated pedigree from new genetic data, many of the offspring in recent years were sired by two fathers, meaning that less than 30 individuals make up the effective reproducing portion of the population. Because a small number of males were identified as the fathers of many offspring, a smaller number may be sufficient to support population growth than was previously thought (Ford et al. 2011; Ford et al. 2018). However, the consequence of this means inbreeding may be common amongst this small population, with a recent study by Ford et al. (2018) finding several offspring resulting from matings between parents and their own offspring. The fitness effects of this inbreeding remain unclear and are an effort of ongoing research (Ford et al. 2018).

Seasonal mortality rates among Southern and Northern Resident whales may be highest during the winter and early spring, based on the numbers of animals missing from pods returning to inland waters each spring and standings data. Olesiuk et al. (2005) identified high neonatal mortality that occurred outside of the summer season, and multiple new calves have been documented in winter months that have not survived the following summer season (Center for Whale Research, unpublished data). Stranding rates are higher in winter and spring for all killer whale forms in Washington and Oregon (Norman et al. 2004) and a recent review of killer whale strandings in the northeast Pacific provided insight into health, nutritional status and causes of mortality for all killer whale ecotypes (Raverty et al. 2020).

The NWFSC continues to evaluate changes in fecundity and mortality rates, and has updated the population viability analyses conducted for the 2004 Status Review for SRKWs and the 2011 science panel review of the effects of salmon fisheries (Krahn et al. 2004; Hilborn et al. 2012; Ward et al. 2013) and the most recent 5-year review (NMFS 2017). The updated analysis described the recent changes in population size and age structure, change in demographic rates over time, and updated projections of population viability (Ward 2019). According to Ward (2019), the model results indicate that fecundity rates have declined and have changed more than male or female survival since 2010. Ward (2019) performed a series of projections: (1) projections using fecundity and survival rates estimated over the long-term data series (1985 to 2019); (2) projections using fecundity and survival rates from the most recent 5-year period (2014 to 2019); and (3) projections using the highest fecundity and survival rates estimated (in the period 1985 to 1989). The most optimistic scenario, using demographic rates calculated from the 1985 to1989 period, has a trajectory that increases and eventually declines after 2030, while the scenario with long-term demographic data, or the scenario only including the most recent years' demographic data, projects declines. Additional runs for this scenario (1985 to1989 data) indicated a similar trajectory with a 50:50 sex ratio. Thus, the downward trends are likely driven by the current age and sex structure of young animals in the population (from 2011-2016 new births were skewed slightly toward males with 64 percent male), as well as the number of older animals (Ward 2019). As the model projects out over a longer time frame (50 years) there is increased uncertainty around the estimates. The downward trend is in part due to the changing age and sex structure of the population. If the population of SRKW experiences demographic rates (e.g. fecundity and mortality) that are more similar to 2016 than the recent 5-year average (2011 to 2016), the population will decline faster as shown in Figure 7 (NMFS 2016b). There are several demographic factors of the SRKW population that are cause for concern, namely (1) reduced fecundity; (2) a skewed sex ratio toward male births in recent years; (3) a lack of calf production from certain components of the population (e.g. K pod); (4) a small number of adult males acting as sires (Ford et al. 2018); and (5) an overall small number of individuals in the population (NMFS 2016b).

Because of the whales' small population size, the population is also susceptible to increased risks of demographic stochasticity—randomness in the pattern of births and deaths among individuals in a population. Several sources of demographic variance (e.g. differences between individuals or within individuals) can affect small populations and contribute to variance in a population's growth and increased extinction risk. Sources of demographic variance can include environmental stochasticity, or fluctuations in the environment that drive changes in birth and death rates, and demographic heterogeneity, or variation in birth or death rates of individuals because of differences in their individual fitness (including sexual determinations). In combination, these and other sources of random variation combine to amplify the probability of extinction, known as the extinction vortex (Gilpin and Soulé 1986; Fagan and Holmes 2006; Melbourne and Hastings 2008). The larger the population size, the greater the buffer against stochastic events and genetic risks.

Population-wide distribution of lifetime reproductive success of SRKWs can be highly variable, such that some individuals produce more offspring than others to subsequent generations, and male variance in reproductive success can be greater than that of females (e.g. Clutton-Brock 1998; Hochachka 2006). For long-lived vertebrates such as killer whales, some females in the population might contribute less than the number of offspring required to maintain a constant population size (n = 2), while others might produce more offspring. The smaller the population, the more weight an individual's reproductive success has on the population's growth or decline (Coulson et al. 2006). For example, the overall number of reproductive females has been fluctuating between 25 and 35 for most of the last 40 years, and there have been contrasting changes by pod, with declines in L pod females and increases in J pod (Ward 2019). At the start of the survey in 1976, the distribution of females was skewed toward younger ages with few older, post-reproductive females. The distribution in recent years is more uniform across female ages (in other words, more females in their 30s, (Ward 2019)). However, from 2014 through July 2019, only 7 calves were born and survived (3 in J pod and 4 in L pod) (Ward 2019). In a novel study, researchers collected SRKW feces to measure pregnancy hormones (progesterone and testosterone) (Wasser et al. 2017). The fecal hormone data showed that up to 69 percent of the detected pregnancies do not produce a documented calf, and an unprecedented half of those failed pregnancies occurred relatively later in the pregnancy when energetic costs and physiological risk to the mother are higher (Wasser et al. 2017). Recent aerial imagery corroborates this high rate of loss (Fearnbach and Durban unpubl. data). The congruence between the rate of loss estimates from fecal hormones and aerial photogrammetry suggests the majority of the loss is in the latter half of pregnancy when photogrammetry can detect anomalous shape after several months of gestation (Durban et al. 2016). Although the rates of successful pregnancies in wild killer whale populations is generally unknown, a relatively high level of reproductive failure late in pregnancy is uncommon in mammalian species and suggests there may be cause for concern.

Limiting Factors and Threats. Several factors identified in the recovery plan for SRKW may be limiting recovery. The recovery plan identified three major threats including (1) the quantity and quality of prey; (2) toxic chemicals that accumulate in top predators; and (3) impacts from sound and vessels. Oil spills and disease as well as the small population size are also risk factors. It is likely that multiple threats are acting together to impact SRKWs. Modeling exercises have attempted to identify which threats are most significant to survival and recovery (e.g. Lacy et al. 2017) and available data suggest that all of the threats are potential limiting factors (NMFS 2008).

Quantity and Quality of Prey. SRKWs have been documented to consume a variety of fish species (22 species) and one species of squid (Ford et al. 1998; Ford et al. 2000; Ford and Ellis 2006; Hanson and Emmons 2010; Ford et al. 2016), but salmon are identified as their primary prey. The best available information suggests an overall preference for Chinook salmon (during the summer and fall). Chum salmon, coho salmon, and steelhead may also be important in the SRKW diet at particular times and in specific locations. Rockfish (*Sebastes spp*.), Pacific halibut (*Hippoglossus stenolepis*), and Pacific herring (*Clupea pallasi*) were also observed during predation events (Ford and Ellis 2006), however, these data may underestimate the extent of feeding on bottom fish (Baird 2000). A number of smaller flatfish, lingcod (*Ophiodon elongatus*), greenling (*Hexagrammos spp*.), and squid have been identified in stomach content analysis of resident whales (Ford et al. 1998).

SRKWs are the subject of ongoing research, the majority of which has occurred in inland waters of Washington State and British Columbia, Canada during summer months and includes direct observation, scale and tissue sampling of prey remains, and fecal sampling. The diet data suggest that SRKWs are consuming mostly larger (i.e., generally age 3 and up) Chinook salmon (Ford and Ellis 2006). Chinook salmon is their primary prey despite the much lower abundance in comparison to other salmonids in some areas and during certain time periods (Ford and Ellis 2006). Factors of potential importance include the species' large size, high fat and energy content, and year-round occurrence in the SRKW's geographic range. Chinook salmon have the highest value of total energy content compared to other salmonids because of their larger body size and higher energy density (kilocalorie/kilogram (kcal/kg)) (O'Neill et al. 2014). For example, in order for a SRKW to obtain the total energy value of one adult Chinook salmon, they would need to consume approximately 2.7 coho, 3.1 chum, 3.1 sockeye, or 6.4 pink salmon (O'Neill et al. 2014). Research suggests that SRKWs are capable of detecting, localizing, and recognizing Chinook salmon through their ability to distinguish Chinook salmon echo structure as different from other salmon (Au et al. 2010). The degree to which killer whales are able to or willing to switch to non-preferred prey sources (i.e., prey other than Chinook salmon) is also largely unknown, and likely variable depending on the time and location.

Over the last forty years, predation on Chinook salmon off the West Coast of North America by marine mammals has been estimated to have more than doubled (Chasco et al. 2017). In particular, southern Chinook salmon stocks ranging south from the Columbia River have been subject to the largest increases in predation, and Chasco et al. (2017) suggested that SRKWs may be the most disadvantaged compared to other more NRKW populations given the northern migrations of Chinook salmon stocks in the ocean and this competition may be limiting the growth of the SRKW population.

Evidence of reduced growth and poor survival in SRKW and NRKW populations at a time when Chinook salmon abundance was low suggests that low abundance may have contributed to nutritional deficiency with serious effects on individual whales. Reduced body condition and body size has been observed in SRKW and NRKW populations. For example, Groskreutz et al. (2019) used aerial photogrammetry to measure growth and length in adult NRKW, which prey on similar runs of Chinook salmon, from 2014 to 2017. Given that killer whales physically mature at age 20 and the body stops growing (Noren 2011), we would expect adult male killer whales to all have similar body lengths and all adult female killer whales to have similar body lengths. However, Groskreutz et al. (2019) found adult whales that were 20 – 40 years old have significantly shorter body lengths than those older than 40 years of age, suggesting the younger mature adults had experienced inhibited growth. Similarly, adult Southern Residents under 30 years of age that were measured in 2008 by the same photogrammetric technique were also shorter on average than older individuals also suggesting reduced growth (Fearnbach et al. 2011).

What appears to be constrained growth in both resident killer whale populations occurred in the 1990s during a time when range-wide abundance of Chinook salmon in multiple subsequent years fell below the 1979–2003 average (Ford et al. 2010). The low Chinook salmon abundance and smaller growth in body size in whales coincided with an almost 20 percent decline from 1995 to 2001 (from 98 whales to 81 whales) in the SRKW population (NMFS 2008b). During this period of decline, multiple deaths occurred in all three pods of the SRKW population and relatively poor survival occurred in nearly all age classes and in both males and females. The NRKWs also experienced population declines during the late 1990s and early 2000s. Hilborn et al. (2012) stated that periods of decline across killer whale populations "suggest a likely common causal factor influencing their population demographics" (Hilborn et al. 2012).

During this same general period of time of low Chinook salmon abundance, declining body size in whales, and declining resident killer whale populations, all three SRKW pods experienced substantially low social cohesion (Parsons et al. 2009). This temporal shift in SRKW social cohesion may reflect a response to changes in prey. (Foster et al. 2012) similarly found a significant correlation between SRKW social network connectivity and Chinook salmon prey abundance for the years 1984-2007, where in years with higher Chinook salmon abundance, SRKW social network was more interconnected. The authors discuss that because of this result, years with higher Chinook salmon abundance may lead to more opportunities for mating and information transfer between individuals.

A recent study used an integrated population modeling framework to evaluate how the abundance of Chinook salmon stocks in the eastern Pacific may impact the survival and fecundity rates of SRKWs (Nelson et al. 2024). The authors used a sex- and age-structured population model to simulate the dynamics of the SRKW population between 1940 and 2020. They explained that previous work that assessed the relationship between Chinook salmon abundance and SRKW birth and death rates modeled these processes independently, despite the possibility that they may be correlated (Ford et al. 2010; Ward et al. 2009, 2016). After explicitly accounting for several sources of uncertainty in the population dynamics of SRKWs, the authors found modest evidence that Chinook salmon abundance is positively associated with survival rates, and minimal evidence of an association with birth rates. They concluded that those findings, combined with previous research, suggest the recovery of SRKWs may be limited by prey availability, and that the current population size appears to be below carrying capacity (Nelson et al. 2024).

Toxic Chemicals. Various adverse health effects in humans, laboratory animals, and wildlife have been associated with exposures to persistent pollutants. These pollutants have the ability to cause endocrine disruption, reproductive disruption or failure, immunotoxicity, neurotoxicity, neurobehavioral disruption, and cancer (Reijnders 1986; Subramanian et al. 1987; de Swart et al. 1996; Bonefeld-Jørgensen et al. 2001; Reddy et al. 2001; Schwacke et al. 2002; Darnerud 2003; Legler and Brouwer 2003; Viberg et al. 2003; Ylitalo et al. 2005; Fonnum et al. 2006; Darnerud 2008; Legler 2008). SRKWs are exposed to a mixture of pollutants, some of which may interact synergistically and enhance toxicity, influencing their health, and reproduction. Relatively high levels of these pollutants have been measured in blubber biopsy samples from SRKWs compared to other resident killer whales in the North Pacific (Ross et al. 2000; Krahn et al. 2007; Krahn et al. 2009; Lawson et al. 2020), and more recently, these pollutants were measured in fecal samples collected from SRKWs providing another potential opportunity to evaluate exposure to these pollutants (Lundin et al. 2016a; Lundin et al. 2016b).

SRKWs are exposed to persistent pollutants primarily through their diet. For example, Chinook salmon contain higher levels of some persistent pollutants than other salmon species when comparing the limited information available for pollutant levels in Chinook salmon (Krahn et al. 2007; O'Neill and West 2009; Veldhoen et al. 2010; Mongillo et al. 2016). These harmful pollutants, through consumption of prey species that contain these pollutants, are stored in the blubber and can later be released; when the pollutants are released, they are redistributed to other tissues when the SRKWs metabolize the blubber, for example, responses to food shortages or reduced acquisition of food energy as one possible stressor. The release of pollutants can also occur during gestation or lactation. Once the pollutants mobilize from the blubber into circulation, they have the potential to cause a toxic response. Therefore, nutritional stress from reduced Chinook salmon populations may act synergistically with high pollutant levels in SRKWs and result in adverse health effects.

Noise and vessels
Killer whales rely on their highly developed acoustic sensory system for navigating, locating prey, and communicating with other individuals. While in inland waters of Washington and British Columbia, SRKWs are the principal target species for the commercial whale watch industry (Hoyt 2001; O'Connor et al. 2009) and encounter a variety of other vessels in their urban environment (e.g., recreational, fishing, ferries, military, shipping). Several main threats from vessels include direct vessel strikes (which can result in injury or mortality (Gaydos and Raverty 2007)), the masking of echolocation and communication signals by anthropogenic sound, and behavioral changes (NMFS 2008). There is a growing body of evidence documenting effects from vessels on small cetaceans and other marine mammals. Research has shown that SRKWs spend more time traveling and performing surface active behaviors and less time foraging in the presence of all vessel types, including kayaks, and that noise from motoring vessels up to 400 meters away has the potential to affect the echolocation abilities of foraging whales (Holt 2008; Lusseau et al. 2009; Noren et al. 2009; Williams et al. 2010). Individual energy balance may be impacted when vessels are present because of the combined increase in energetic costs resulting from changes in whale activity with the decrease in prey consumption resulting from reduced foraging opportunities (Williams et al. 2006; Lusseau et al. 2009; Noren et al. 2009; Noren et al. 2012).

In addition to vessels, underwater sound can be generated by a variety of other human activities, such as dredging, drilling, construction, seismic testing, and sonar (Richardson et al. 1995; Gordon and Moscrop. 1996; National Research Council 2003). Impacts from these sources can range from serious injury and mortality to changes in behavior. In other cetaceans, hormonal changes indicative of stress have been recorded in response to intense sound exposure (Romano et al. 2003). Chronic stress is known to induce harmful physiological conditions including lowered immune function, in terrestrial mammals and likely does so in cetaceans (Gordon and Moscrop. 1996).

Climate Change and Other Ecosystem Effects. In Section 2.2, above, we briefly discussed climate change and the stress it can bring to the ESA-listed species and habitats considered in this Opinion. In a broader view, overwhelming data indicate the planet is warming (IPCC 2014), which poses a threat to many species. Climate change has the potential to impact species abundance, geographic distribution, migration patterns, timing of seasonal activities (IPCC 2014), and species viability into the future. Changes in climate and ocean conditions happen on several different time scales and have had a profound influence on distributions and abundances of marine and anadromous fishes.

Climate change is expected to impact anadromous fish during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in stream flow patterns in freshwater and changes to food webs in freshwater, estuarine and marine habitats. There is high certainty that predicted physical and chemical changes will occur; however, the ability to predict biological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty.

Pacific Northwest anadromous fish inhabit as many as three marine ecosystems during their ocean residence period: the Salish Sea, the California Current, and the Gulf of Alaska (Brodeur et al. 1992; Weitkamp and Neely 2002; Morris et al. 2007). The response of these ecosystems to climate change is expected to differ, although there is considerable uncertainty in all predictions. Columbia River and Puget Sound anadromous fish also use coastal areas of British Columbia and Alaska, and mid-ocean habitats in the Gulf of Alaska, although their fine-scale distribution and marine ecology during this period are poorly understood (Morris et al. 2007; Pearcy and McKinnell 2007). Increases in temperature in Alaskan marine waters have generally been associated with increases in productivity and salmon survival (Mantua et al. 1997; Martins et al. 2012).

Warmer streams, loss of coastal habitat due to sea level rise, ocean acidification, lower summer stream flows, higher winter stream flows, and changes in water quality and freshwater inputs are projected to negatively affect salmon (e.g. Mauger et al. 2015). The persistence of cold water "refugia" within rivers and the diversity among salmon populations will be critical in helping salmon populations adapt to future climate conditions. More detailed discussions about the likely effects from climate change in freshwater systems on salmonids can be found in biological opinions such as the implementation of the Mitchell Act (NMFS 2017b).

In marine waters, increasing temperatures are associated with observed and predicted poleward range expansions of fish and invertebrates in both the Atlantic and Pacific oceans (Lucey and Nye 2010; Asch 2015; Cheung et al. 2015). Rapid poleward species shifts in distribution in response to anomalously warm ocean temperatures have been well documented in recent years, confirming this expectation at short time scales. Range extensions were documented in many species from southern California to Alaska during unusually warm water associated with "the blob" in 2014 and 2015 (Bond et al. 2015; Di Lorenzo and Mantua 2016), and past strong El Nino events (Pearcy 2002; Fisher et al. 2015).

The potential impacts of climate and oceanographic change on whales and other marine mammals will likely involve effects on habitat availability and food availability. For species that depend on salmon for prey, such as SRKWs, the fluctuations in salmon survival that occur with these changes in climate conditions can have negative effects. Site selection for migration, feeding, and breeding may be influenced by factors such as ocean currents and water temperature. For example, there is some evidence from Pacific equatorial waters that sperm whale feeding success and, in turn, calf production rates are negatively affected by increases in sea surface temperature (Smith and Whitehead 1993; Whitehead 1997). Different species of marine mammals will likely react to these changes differently. MacLeod (2009) estimated, based on expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, with 47 percent likely to be negatively affected. Range size, location, and whether or not specific range areas are used for different life history activities (e.g. feeding, breeding) are likely to affect how each species responds to climate change (Learmonth et al. 2007).

Although few predictions of impacts on the Southern Residents have been made, it seems likely that any changes in weather and oceanographic conditions resulting in effects on salmon populations would have consequences for the whales. SRKWs might shift their distribution in response to climate-related changes in their salmon prey. Persistent pollutant bioaccumulation may also change because of changes in the food web.

Recent analysis ranked the vulnerability of West Coast salmon stocks to climate change and, of the top priority stocks for Southern Residents (NMFS and WDFW 2018), California Central Valley Chinook salmon stocks, Snake river fall and spring/summer Chinook salmon, Puget Sound Chinook salmon, and spring-run Chinook salmon stocks in the interior Columbia and Willamette River basins were ranked as "high" or "very high" vulnerability to climate change (Crozier et al. 2019). In general, Chinook, coho, and sockeye salmon runs were more vulnerable and this stemmed from exposure to higher ocean and river temperatures as well as exposure to changes in flow regimes (including in relation to snowpack, upwelling, sea level rise, and flooding). However, certain Chinook salmon runs do have higher ability to adapt and/or cope with climate change due to high life history diversity in juveniles and adults (including both subyearling and yearling smolts, multiple migration timings), but diversity may be lost with future climate change. Overall, chum and pink salmon were less vulnerable to climate change because they spend less time in fresh water than other salmonids, and certain steelhead runs had more moderate vulnerability than many Chinook and coho salmon runs because of higher resilience (Crozier et al. 2019).

2.2.2 Status of the Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that habitat throughout the designated areas. These features are essential to the conservation of the PS Chinook salmon because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging). As stated above, there is no designated critical habitat for Puget Sound steelhead in the action area.[14]

Puget Sound Chinook Salmon Critical Habitat
Critical habitat for PS Chinook salmon was designated on September 2, 2005 (70 FR 52630). Critical habitat includes 1,683 miles of streams, 41 square miles of lakes, and 2,182 miles of nearshore marine habitat in Puget Sound. The Puget Sound Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.

As part of the process to designate critical habitat within the PS Chinook salmon ESU, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC_5) 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

[14] Critical habitat for PS steelhead was designated on February 24, 2016 (81 FR 9252). Critical habitat includes 2,031 stream miles; however, nearshore and offshore marine waters were not designated for this species.

In designating critical habitat (CH) for PS Chinook salmon in estuarine and nearshore marine areas, NMFS determined that the area from extreme high water extending out to the maximum depth of the photic zone (no greater than 30 meters relative to MLLW) contain essential features that require special protection. For nearshore marine areas, NMFS designated the area inundated by extreme high tide because it encompasses habitat areas typically inundated and regularly occupied during the spring and summer when juvenile salmon are migrating in the nearshore zone and relying heavily on forage, cover, and refuge qualities provided by these occupied habitats.

Based on the natural history of Puget Sound Chinook salmon and their habitat needs, NMFS identified the following PBFs essential to conservation located within the action areas:

PBF 4 – Estuarine areas free of obstruction and excessive predation with: 1) water quality, water quantity, and salinity conditions that support juvenile and adult physiological transitions between freshwater and saltwater; 2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and 3) juvenile and adult foraging opportunities, including aquatic invertebrates and prey fish, supporting growth and maturation.

PBF 5 – Nearshore marine areas free of obstruction and excessive predation with: 1) water quality and quantity conditions and foraging opportunities, including aquatic invertebrates and fishes, supporting growth and maturation; and 2) natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

Each of the physical and biological features (or primary constituent elements) of estuarine and nearshore marine critical habitat for the Chinook salmon critical habitat have been degraded throughout the Puget Sound region. The causes for these losses of critical habitat value include human development, including diking, filling of wetlands and bays, channelization, and nearshore and floodplain development. Land-use change in the form of development and construction are sources of ongoing anthropogenic modification of the Puget Sound shorelines and is the major factor in the cumulative degradation and loss of nearshore and estuarine habitat. The development of shorelines includes bank hardening and the introduction of obstructions in the nearshore area. Each obstruction is a source of structure and shade, which can interfere with juvenile salmonid migration and diminish aquatic food supply, and is a potential source of water pollution from boating uses (Shipman et al. 2010; Fresh et al. 2011; Morley et al. 2012).

Critical habitat throughout the Puget Sound basin has been degraded by numerous activities, including hydropower development, historic loss of mature riparian forests, increased sediment inputs, removal of large woody debris, intense urbanization, agriculture, alteration of floodplain and stream morphology, riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, timber harvest, and mining. Changes in habitat quantity, availability, diversity, stream flow, temperature, sediment load, and channel instability are common limiting factors of critical habitat.

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and large wood. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses. Wetlands play an important role in hydrologic processes, as they store water that ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Spence et al. 1996; SSPS 2007).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of turbidity, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries (SSPS 2007). Landslides can occur naturally in steep, forested lands, but inappropriate land use practices likely have accelerated their frequency and the amount of sediment delivered to streams. Fine sediment from unpaved roads has also contributed to stream sedimentation. Unpaved roads are widespread on forested lands in the Puget Sound basin, and to a lesser extent, in rural residential areas. Historical logging removed most of the riparian trees near stream channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced stream shade and large wood recruitment (SSPS 2007).

Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clear cuts (SSPS 2007).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS salmon and steelhead populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat (e.g., Elwha River dams block anadromous fish access to 70 miles of potential habitat) changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and large wood to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (prey source) productivity (Hunter 1992).

Juvenile deaths in this context occur in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion head gates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system (WDFW 2009). Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (SSPS 2007).

The degradation of multiple aspects of PS Chinook critical habitat in the nearshore indicates that the conservation potential of the critical habitat is not being reached, even in areas where the conservation value of habitat is ranked high. The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (SSPS 2007).

Degradation of the nearshore environment has occurred in the southeastern areas of Hood Canal in recent years, resulting in late summer marine oxygen depletion and significant fish kills. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has degraded certain physical and chemical characteristics of the near-shore environment (HCCC 2005; SSPS 2007).

The NMFS has completed several section 7 consultations on large-scale habitat projects affecting listed species in Puget Sound. Among these are the Washington State Forest Practices Habitat Conservation Plan (NMFS 2006b), and consultations on Washington State Water Quality Standards (NMFS 2008c), the National Floodplain Insurance Program (NMFS 2008d), and the Elwha River Fish Restoration Plan (Ward et al. 2008).

In 2012, the Puget Sound Action Plan was also developed with several federal agencies (e.g., Environmental Protection Agency, NOAA Fisheries, the Corps of Engineers, Natural Resources Conservation Service, United States Geological Survey, Federal Emergency Management Agency, and US Fish and Wildlife Service) collaborated on an enhanced approach to implement the Puget Sound Action Plan. On January 18, 2017, the National Puget Sound Task Force reviewed and accepted the Interim Draft of the Puget Sound Federal Task Force Action Plan FY 2017-202129. The purpose of the Puget Sound Federal Task Force Action Plan is to contribute toward realizing a shared vision of a healthy and sustainable Puget Sound ecosystem by leveraging Federal programs across agencies and coordinating diverse programs on a specific suite of priorities.

As discussed in the Status of the species section, the abundance of Chinook salmon in recent years is significantly less than historic abundance due to a number of human activities. The most notable human activities that cause adverse effects on ESA-listed and non-ESA-listed salmon include: land use activities that result in habitat loss and degradation, hatchery practices, harvest and hydropower systems.

As mentioned previously, numerous factors have led to the decline of PS Chinook salmon including overharvest, freshwater and marine habitat loss, hydropower development, and hatchery practices, as mentioned in Section 2.2.1, above. Adjustments can, and have been made in the short term to ameliorate some of the factors for decline. Harvest can be adjusted on yearly or even in-season basis.

Since PS Chinook salmon were listed, harvest in state, tribal, and federal fisheries has been reduced in an effort to increase the number of adults returning to spawning grounds. Likewise, hatchery management can, and has been adjusted relatively quickly when practices are detrimental to listed species. To address needed improvements in hydropower, NMFS has issued biological opinions with reasonable and prudent alternatives to improve fish passage at existing hydropower facilities.

Unlike the other factors, however, loss of critical habitat quality is much more difficult to address in the short term. Once human development causes loss of critical habitat quality, that loss tends to persist for decades or longer. The condition of critical habitat will improve only through active restoration or natural recovery following the removal of human infrastructure. As noted throughout this Opinion, future effects of climate change on habitat quality throughout Puget Sound are expected to be negative.

Habitat use by Chinook salmon in the Puget Sound area has been historically limited by large dams and other man-made barriers in a number of drainages, including the Nooksack, Skagit, White, Nisqually, Skokomish, and Elwha river basins. In addition to limiting habitat accessibility, dams affect habitat quality through changes in river hydrology, altered temperature profile, reduced downstream gravel recruitment, and the reduced recruitment of large woody debris. Such changes can have significant negative impacts on salmonids (e.g., increased water temperatures resulting in decreased disease resistance) (Spence et al. 1996; McCullough 1999).

More recently, stakeholders and other interested entities have worked to address habitat barriers, reducing the number of basins with limited anadromous access to historical habitat. The completion of the Elwha and Glines Canyon dam removals occurred in 2014. The response of fish populations to this action is still being evaluated. Now, Chinook salmon are accessing much of this newly available habitat (Pess et al. 2020).

Improvements in the adult fish collection facility at Mud Mountain Dam (White River basin) are near completion, with the expectation that improvements in adult survival (including of PS Chinook) will facilitate better utilization of habitat above the dam (NMFS 2014).

The recent removal of the diversion dam on the Middle Fork Nooksack Dam (16 July 2020) and the Pilchuck River Dam (late 2020) will provide access to important headwater salmonid spawning and rearing habitats. Similarly, the proposed modification of Howard Hanson Dam for upstream fish passage and downstream juvenile collection in the longer term (NMFS 2019b) will allow winter steelhead to return to historical habitat (Ford 2022).

Additionally, approximately 8,000 culverts that block salmonid habitat have been identified in Puget Sound (NMFS 2019), with plans to address these blockages being extended over many years. Smaller scale improvements in habitat, restoration of riparian habitat and reconnecting side- or off-channel habitats, will allow better access to habitat types and niche diversification. While there have been some significant improvements in restoring access, it is recognized that land development, loss of riparian and forest habitat, loss of wetlands, demands on water allocation all continue to degrade the quantity and quality of available fish habitat (Ford 2022).

In summary, even with restoration success, like dam removal and blocked culverts being addressed, critical habitat for salmon throughout the Puget Sound basin continues to be degraded by numerous management activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large wood, intense urbanization, agriculture, alteration of floodplain and stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors in areas of critical habitat. As mentioned above, development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of marine habitat for PS salmonids. Projected changes in nearshore and estuary development based on documented rates of developed land cover change in Bartz et al. (2015) show that between 2008 and 2060, an additional 14.7 hectares of development of shoreline areas and 204 hectares of estuary development can be expected.[15]

SRKW Critical Habitat

Critical habitat for the SRKW DPS was designated on November 29, 2006 (71 FR 69054). Critical habitat includes approximately 2,560 square miles of inland waters of Washington in three specific areas: (1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca. Based on the natural history of SRKWs and their habitat needs, NMFS identified the following physical or biological features essential to conservation: (1) Water quality to support growth and development; (2) Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) Passage conditions to allow for migration, resting, and foraging.

In 2006, few data were available on SRKWs distribution and habitat use in coastal waters of the Pacific Ocean. Since the 2006 designation, additional effort has been made to better understand the geographic range and movements of SRKWs. For example, opportunistic visual sightings, satellite tracking, and passive acoustic research conducted since 2006 have provided an updated estimate of the whales’ coastal range that extends from the Monterey Bay area in California, north to Chatham Strait in southeast Alaska (NMFS 2019c).

On August 2nd, 2021, NMFS revised the critical habitat designation for the SRKW DPS under the ESA by designating six new areas along the U.S. West Coast (86 FR 41668). Specific new areas proposed along the U.S. West Coast include approximately 15,910 square miles (mi^2) (41,207 square kilometers (km^2)) of marine waters between the 6.1-meter (m) depth contour and

[15] Memorandum from Tim Beechie, Northwest Fisheries Science Center, to Kim Kratz, et al. NMFS, regarding projected developed land cover change in Puget Sound nearshore and estuary zones. (June 23, 2020).

the 200-m depth contour from the U.S. international border with Canada south to Point Sur, California). In the final rule (86 FR 41668), NMFS states that the “designated areas are occupied and contain physical or biological features that are essential to the conservation of the species and that may require special management considerations or protection.” The three physical or biological features essential to conservation in the 2006 designated critical habitat were also identified for the six new areas along the U.S. West Coast.

Based on the natural history of SRKW and their habitat needs, NMFS identified the following PBFs essential to conservation located within the action areas:

Water Quality to Support Growth and Development. Water quality supports SRKW’s ability to forage, grow, and reproduce free from disease and impairment. Water quality is essential to the whales’ conservation, given the whales’ present contamination levels, small population numbers, increased extinction risk caused by any additional mortalities, and geographic range (and range of their primary prey) that includes highly populated and industrialized areas. Water quality is especially important in high-use areas where foraging behaviors occur and contaminants can enter the food chain. The absence of contaminants or other agents of a type and/or amount that would inhibit reproduction, impair immune function, result in mortalities, or otherwise impede the growth and recovery of the SRKW population is a habitat feature essential for the species’ recovery. Water quality in Puget Sound, in general, is degraded as described in the Puget Sound Partnership 2018-2022 Action Agenda and Comprehensive (PSP 2018). For example, toxicants in Puget Sound persist and build up in marine organisms including SRKWs and their prey resources, despite bans in the 1970s of some harmful substances and cleanup efforts. Water quality varies in coastal waters from Washington to California. For example, as described in NMFS (2019c), high levels of DDTs have been found in SRKWs, especially in K and L pods, which spend more time in California in the winter where DDTs still persist in the marine ecosystem (Sericano et al. 2014).

Exposure to oil spills also poses additional direct threats as well as longer term population level impacts; therefore, the absence of these chemicals is of the utmost importance to SRKW conservation and survival. Oil spills can also have long-lasting impacts on other habitat features. Oil spill risk exists throughout the SRKW’s coastal and inland range. From 2002-2016, the highest-volume crude oil spill occurred in 2008 off the California coast, releasing 463,848 gallons (Stephens 2017). In 2015 and 2016, crude oil spilled into the marine environment off the California coast totaled 141,680 gallons and 44,755, respectively; no crude oil spills were reported off the coasts of Oregon or Washington in these years (Stephens 2015, Stephens 2017). Non-crude oil spills into the marine environment also occurred off California, Oregon, and Washington in 2015 and 2016 (Stephens 2015, Stephens 2017). The Environmental Protection Agency and U.S. Coast Guard oversee the Oil Pollution Prevention regulations promulgated under the authority of the Federal Water Pollution Control Act. There is a Northwest Area Contingency Plan, developed by the Northwest Area Committee, which serves as the primary guidance document for oil spill response in Washington and Oregon. In 2017, the Washington State Department of Ecology published a new Spill Prevention, Preparedness, and Response Program Annual Report describing the Spills Program as well as the performance measures from 2007–17 (WDOE 2017).

Prey Species of Sufficient Quantity, Quality, and Availability to Support Individual Growth, Reproduction, and Development, as well as Overall Population Growth. SRKW are top of the food chain predators with a strong preference for salmonids in inland waters, particularly larger, older age class Chinook salmon (age class of 3 years or older) (Ford and Ellis 2006, Hanson and Emmons 2010). Samples collected during observed feeding activities, as well as the timing and locations of killer whales' high use areas that coincide with Chinook salmon runs, suggest the whales' preference for Chinook salmon extends to outer coastal habitat use as well (Hanson et al. 2017, Hanson et al. 2021). Quantitative analyses of diet from fecal samples indicate a high proportion of Chinook salmon in the diet of whales feeding in waters off the coast but a greater diversity of species, which included substantial contributions of other salmon and also lingcod, halibut, and steelhead (Hanson et al. 2021). Habitat conditions should support the successful growth, recruitment, and sustainability of abundant prey to support the individual growth, reproduction, and development of Southern Residents.

Most wild salmon stocks throughout the whales' geographic range are at fractions of their historic levels. Beginning in the early 1990s, 28 ESUs and DPSs of salmon and steelhead in Washington, Oregon, Idaho, and California were listed as threatened or endangered under the ESA. Historically, overfishing, habitat losses, and hatchery practices were major causes of decline. Poor ocean conditions over the past two decades have reduced populations already weakened by the degradation and loss of freshwater and estuary habitat, fishing, hydropower system management, and hatchery practices. While wild salmon stocks have declined in many areas, hatchery production has been generally strong.

In addition to a sufficient quantity of prey, those fish need to be accessible and available to the whales. Depending on pod migratory behavior, availability of Chinook salmon along the outer coast is likely limited at particular times of year (e.g. winter months) due to run timing of various Chinook salmon stocks. Prey availability may also be low when the distribution of preferred adult Chinook salmon is relatively less dense (spread out) prior to their aggregation when returning to their natal rivers. Prey availability may also be affected by competition from other predators including other resident killer whales, pinnipeds, and fisheries (Chasco et al. 2017).

Contaminants and pollution also affect the quality of SRKW prey in Puget Sound and in coastal waters of Washington, Oregon, and California. Contaminants enter marine waters and sediment from numerous sources, but are typically concentrated near areas of high human population and industrialization. Once in the environment these substances proceed up the food chain, accumulating in long-lived top predators like SRKWs. Chemical contamination of prey is a potential threat to SRKW critical habitat, despite the enactment of modern pollution controls in recent decades, which were successful in reducing, but not eliminating, the presence of many contaminants in the environment. The size of Chinook salmon is also an important aspect of prey quality (i.e., SRKWs primarily consume large Chinook salmon) so changes in Chinook salmon size (for instance as shown by Ohlberger et al. (2018)) may affect the quality of this component critical habitat.

Passage Conditions to Allow for Migration, Resting, and Foraging. Southern Residents are highly mobile and use a variety of areas for foraging and other activities, as well as for traveling between these areas. Human activities can interfere with movements of the whales and impact their passage. Southern Residents require open waterways that are free from obstruction (e.g., physical, acoustic) to move within and migrate between important habitat areas throughout their range, communicate, find prey, and fulfill other life history requirements. In particular, vessels may present obstacles to whale passage, causing the whales to swim further and change direction more often, which can increase energy expenditure for whales and impact foraging behavior (Ferrara et al. (2017).

A summary of the status of critical habitat, considered in this opinion, is provided in Table 7.

Table 7. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this opinion

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Puget Sound Chinook salmon	9/02/05 70 FR 52630	Critical habitat for PS Chinook salmon includes 1,683 miles of streams, 41 square miles of lakes, and 2,182 miles of nearshore marine habitat in PS. The PS Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.
Southern resident killer whale	08/02/21 86 FR 41668	Critical habitat includes approximately 2,560 square miles of marine inland waters of Washington: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Six additional areas include 15,910 square miles of marine waters between the 20-feet (ft) (6.1-meter (m)) depth contour and the 656.2-ft (200-m) depth contour from the U.S. international border with Canada south to Point Sur, California. We have excluded the Quinault Range Site. Based on the natural history of the Southern Residents and their habitat needs, NMFS identified three PCEs, or physical or biological features, essential for the conservation of Southern Residents: 1) Water quality to support growth and development; 2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and 3) passage conditions to allow for migration, resting, and foraging. Water quality in Puget Sound, in general, is degraded. Some pollutants in Puget Sound persist and build up in marine organisms including Southern Residents and their prey resources, despite bans in the 1970s of some harmful substances and cleanup efforts. The primary concern for direct effects on whales from water quality is oil spills, although oil spills can also have long-lasting impacts on other habitat features In regards to passage, human activities can interfere with movements of the whales and impact their passage. In particular, vessels may present obstacles to whales' passage, causing the whales to swim further and change direction more often, which can increase energy expenditure for whales and impact foraging behavior. Reduced prey abundance, particularly Chinook salmon, is also a concern for critical habitat.

2.3 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 Corp's proposed action is the exercise of its permit authorities for the No Name Slough tidegate replacement project. The action area consists of all the areas where the environmental effects of the proposed action are expected to occur. The proposed action would cause a range of effects, as described in Section 2.5, Effects of the Action, including the temporary effects that occur and relent during construction, the enduring effects of those structures into the future, and the related, enduring effects on the SRKW prey base. To delineate the action area we identified the geographic extent of all the various effect pathways of the proposed action and determined the outermost extent of all of these zones of effect combined. The construction-related effects occur relatively close to the project site with noise having the largest zone of effect. However, as described in more detail in the following paragraphs, there are other effects that have a greater geographical reach and thus those effects define the action area.

The enduring habitat effects of the proposed structures define the outer limits of the action area on the landward side of the proposed tidegate structures. Impeded access to historical estuarine habitat and changes in water quality will cause physical, chemical (salinity, dissolved oxygen) or biological effects stemming from the action for PS Chinook salmon and steelhead landward of the tidegate project. The effect pathway with greatest geographical reach on the landward side is the loss of juvenile salmonid rearing habitat. Thus, the action area extends landward from the proposed tidegate into No Name Slough and the adjacent floodplains, covering hundreds of acres[16] to reflect the extent of the lost juvenile salmonid rearing habitat attributable to the proposed action.

The indirect, biological effects of the proposed action on the SRKW prey base define the outer limits of the action area on the marine side of the proposed tidegate structures. More specifically, the action area for this consultation includes the zone of effect where greater numbers of PS Chinook salmon would have been available but for the proposed action. Thus, the contours of the marineward side of the action area are grounded in the expected migration pattern/presence of the PS Chinook salmon prey impacted by the proposed action. Best available science shows that Skagit River PS Chinook salmon migrate out into Padilla Bay, among other pathways, and, after that, they travel and are available as prey for SRKW throughout the Puget Sound (Ford and Ellis 2006; Hanson and Emmons 2010; Chamberlin and Quinn 2014). PS Chinook salmon represent the majority of the Chinook salmon consumed by SRKWs in Puget Sound. Hanson et al. 2021, determined that 67 percent of Chinook salmon found in SRKW diet samples collected in Puget Sound were estimated to have originated from Puget Sound. By contrast, outside Puget Sound, SRKW prey on Chinook salmon from multiple areas. (Hanson et al. 2021, Hanson and Emmons 2010). Accordingly, the action area for the proposed action includes all of Puget Sound, but no marine areas beyond.

[16] Under the TFI Agreement, the No Name Slough tidegates being replaced through this action was determined to affect 207 acres of estuarine habitat behind the tidegate (WWAA et al. 2008).

2.4 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).

As identified above, the action area includes Puget Sound and the slough area behind the No Name Slough tidegate. Puget Sound is one of the largest estuaries in the United States, having over 2,400 miles of shoreline, more than two million acres of marine waters and estuarine environment, and a watershed of more than 8.3 million acres. In 1987, Puget Sound was given priority status in the National Estuary Program. This established it as an estuary of national significance under an amendment to the Clean Water Act. In 2006, the Center for Biological Diversity recognized the PS Basin as a biological hotspot with over 7,000 species of organisms that rely on the wide variety of habitats provided by PS (Center for Biological Diversity 2006). There are more than 10,000 streams in the Puget Sound basin. The basin is unique with its historically high salmon species richness and historically high natural salmon productivity (Lombard 2006). However, salmon abundance has decreased 92 percent in Puget Sound streams since 1850 (Gresh et al. 2000), initially due to over-fishing in the late 1800s followed by extensive human development pressures.

The State of the Sound biannual report produced by the Puget Sound Partnership (PSP) (PSP 2019) summarizes how different indicators of health of the PS ecosystem are changing.[17] The assessment identifies that PS marine and freshwater habitats continue to face impacts of accelerating population growth, development, and climate change; and that few of the 2020 improvement targets (including habitat for ESA-listed salmonids) identified by the PSP are being reached.

Over the last 150+ years, 4.5 million people have settled in the PS region. There is a suite of impacts of human development on aquatic habitat conditions in the PS, including water quality effects of stormwater runoff, industrial pollutants and boats, in-water noise from boats and construction activities, and fishing pressure, to name a few (see SSPS 2007; Hamel et al. 2015). With the level of infrastructure development associated with population growth, the PS nearshore has been altered significantly. Major physical changes documented in the PS include the simplification of river deltas, the elimination of small coastal bays, the reduction in sediment supply to the foreshore due to beach armoring, and the loss of tidally influenced wetlands and salt marsh (Fresh et al. 2011).

[17] The Puget Sound Partnership tracks 52 vital sign indicators to measure progress toward different Puget Sound recovery goals. Of the 6 Puget Sound recovery goals, the most relevant for this Opinion include: Thriving species and food webs, Protected and Restored Habitat, Healthy Water Quality and Quantity.

As noted throughout this Opinion, future effects of climate change on habitat quality throughout Puget Sound are expected to be negative.

Between 2020 and 2022 NMFS signed three jeopardy and adverse modification opinions (NMFS 2020, NMFS 2021, NMFS 2022b), finding that several projects the USACE proposed to permit in the Puget Sound (otherwise known as the Salish Sea) nearshore were likely to jeopardize the continued existence of PS Chinook salmon and SRKWs, and adversely modify those species' designated critical habitats. All three of those Opinions included a Reasonable and Prudent Alternative (RPA) to the proposed action that, if implemented, NMFS concluded would not jeopardize PS Chinook salmon or SRKW, or adversely modify those species' designated critical habitats. All of the RPAs required the projects to eliminate or fully offset their enduring effects, such that they would not cause a net reduction in nearshore habitat quality. In 2022, NMFS signed a programmatic biological opinion based on a proposed action from the USACE that has been used to cover almost 200 projects that impacted nearshore areas of the Salish Sea and resulted in effects to ESA listed resources. NMFS 2022c (Salish Sea Nearshore Programmatic, or SSNP). SSNP is a voluntary program that can be used to cover certain projects that propose to repair, maintain, or install new culverts, bridges, utilities, stormwater facilities and outfalls; modify shorelines; install, repair, or replace navigation aids, scientific measurement devices, tideland markers, buoys; maintain, repair, or replace in-water or over-water structures (i.e., piers, ramps, floats, boat ramps, etc.); conduct maintenance dredging; or conduct habitat enhancement activities. Importantly, the SSNP programmatic action, should applicants choose to use it to meet ESA consultation requirements, requires that projects either eliminate or offset their expected enduring effects with a commensurate amount of habitat enhancement or other offsetting activities, which can include, e.g., restoration work or the purchase of conservation credits, in an amount that will fully offset the projects' enduring impacts on Puget Sound nearshore habitat quality. *See also* NMFS 2016c (a predecessor to the Salish Sea Nearshore Programmatic).

Nearshore Habitat in Puget Sound

The Puget Sound Nearshore Ecosystem Restoration Project (PSNERP), an investigation project between the Corps and the state of Washington, reviewed the historical changes to PS's shoreline environment between 1850-1880, and 2000-2006, and found the most pervasive change to PS to be the simplification of the shoreline and reduction in natural shoreline length (Simenstad et al. 2011). Recent studies have estimated the loss of nearshore habitat in PS at close to 85 percent or more (Brophy et al. 2019). Throughout PS, the nearshore areas have been modified by human activity, disrupting the physical, biological, and chemical interactions that are vital for creating and sustaining the diverse ecosystems of PS. The shoreline modifications are usually intended for erosion control, flood protection, sediment management, or for commercial, navigational, and recreational uses. Seventy-four percent of shoreline modification in PS consists of shoreline armoring (Simenstad et al. 2011), which usually refers to bulkheads, seawalls, or groins made of rock, concrete, or wood. Other modifications include jetties and breakwaters designed to dissipate wave energy, and structures such as tidegates, dikes, and marinas, overwater structures, including bridges for railways, roads, causeways, and artificial fill. Analyses conducted in 2011 though the Puget Sound Nearshore Ecosystem Restoration Project (Fresh et al. 2011; Simenstad et al. 2011) found that since 1850, of the approximately 2,470 miles of PS shoreline:

- Shoreline armoring has been installed on 27 percent of PS shores.

- One-third of bluff-backed beaches are armored along half their length. Roads and nearshore fill have each affected about 10 percent of the length of bluff-backed beaches.
- Forty percent of PS shorelines have some type of structure that impacts habitat quality.
- Conversion of natural shorelines to artificial shoreforms occurred in 10 percent of PS.
- There has been a 93 percent loss of freshwater tidal and brackish marshes. The Duwamish and Puyallup rivers have lost nearly all of this type of habitat.
- A net decline in shoreline length of 15 percent as the naturally convoluted and complex shorelines were straightened and simplified. This represents a loss of 1,062 km or 660 miles of overall shoreline length.
- Elimination of small coastal embayments has led to a decline of 46 percent in shoreline length in these areas.
- A 27 percent decline in shoreline length in the deltas of the 16 largest rivers and a 56 percent loss of tidal wetlands in the deltas of these rivers.

Effects of shoreline modification on nearshore and estuarine habitat function include diminished sediment supply, diminished organic material (e.g., woody debris and beach wrack) deposition, diminished over-water (riparian) and nearshore in-water vegetation (SAV), diminished prey availability, diminished aquatic habitat availability, diminished invertebrate colonization, and diminished forage fish populations (see Toft et al. 2007; Shipman et al. 2010; Sobocinski et al. 2010; Morley et al. 2012; Toft et al. 2013; Munsch et al. 2014; Dethier et al. 2016). Shoreline modification, including armoring, often results in increased beach erosion waterward of the armoring, which, in turn, leads to beach lowering, increases in sediment temperature, and reductions in invertebrate density (Fresh et al. 2011; Morley et al. 2012; Dethier et al. 2016).

The reductions to shallow water habitat, as well as reduced forage potential resulting from shoreline modification may cause juvenile salmonids to temporarily utilize deeper habitat, thereby exposing them to increased piscivorous predation. Typical piscivorous juvenile salmonid predators, such as flatfish, sculpin, and larger salmonids, being larger than their prey, generally avoid the shallowest nearshore waters that out-migrant juvenile salmonids prefer. When juvenile salmonids temporarily leave the relative safety of the shallow water, their risk of being preyed upon by other fish increases. This has been shown in the marine environment where juvenile salmonid consumption by piscivorous predators increased fivefold when juvenile pink salmon were forced to leave the shallow nearshore (Willette 2001).

Water Quality

In a typical year in the U.S., pesticides are applied at a rate of approximately five billion pounds of active ingredients per year (Kiely et al. 2004). Therefore, pesticide contamination in the nation's freshwater habitats is ubiquitous and pesticides usually occur in the environment as mixtures. The USGS National Water-Quality Assessment (NAWQA) Program conducted studies and monitoring to build on the baseline assessment established during the 1990s to assess trends of pesticides in basins across the Nation, including PS. More than 90 percent of the time, water from streams within PS agricultural, urban, or mixed-land-use watersheds had detections of 2 or more pesticides or degradates, and about 20 percent of the time they had detections of 10 or more. Fifty-seven percent of 83 agricultural streams had concentrations of at least one pesticide that exceeded one or more aquatic-life benchmarks at least one time during the year (68 percent of sites sampled during 1993–1994, 43 percent during 1995–1997, and 50 percent during 1998–2000) (Gilliom et al. 2006).

Over the last century, human activities have introduced a variety of toxic contaminants into the Salish Sea at levels that can affect adult and juvenile salmonids and/or the prey that support them. Along shorelines, human development has increased nutrient loads from failing septic systems, and from use of nitrate and phosphate fertilizers on lawns and farms (SSPS 2007). The combination of runoff from highways and dense residential, commercial and industrial development has further degraded chemical characteristics of the PS marine environment (HCCC 2005; SSPS 2007; PSEMP 2017; PSEMP 2019). Toxic pollutants in PS include oil and grease, polychlorinated biphenyls (PCBs), phthalates, polybrominated diphenyl ethers (PBDEs), and heavy metals that include zinc, copper, and lead. In addition to degraded water quality, about 32 percent of the sediments in the PS region are considered to be moderately or highly contaminated (PSAT 2007). Despite some areas undergoing clean-up operations that have improved benthic habitats (Sanga 2015), contamination of these chemicals in fish, including PS Chinook salmon and steelhead persists (West et al. 2017; Carey et al. 2018).

Mackenzie et al. (2018) found that stormwater is the most important pathway to PS for most toxic contaminants, transporting more than half of the PS's total known toxic load (Ecology and King County 2011). During a robust PS monitoring study, toxic chemicals were detected more frequently and at higher concentrations during storm events compared with base flow for diverse land covers, pointing to stormwater pollution (Ecology 2011). The PS basin has over 4,500 unnatural surface water and stormwater outfalls, 2,121 of which discharge directly into the Sound (WDNR 2015).

In general, the pollutants in the existing stormwater discharge are diverse. The discharge itself comes from rainfall or snowmelt moving over and through the ground, also referred to here as "runoff." As the runoff travels along its path, it picks up and carries away natural and anthropogenic pollutants. Pollutants in stormwater discharge typically include the following (Buckler and Granato 1999; Strecker et al. 1990; Kayhanian et al. 2003; Stokstad 2020; Tian et al. 2021):

- Excess fertilizers, herbicides, insecticides and sediment from landscaping areas.
- Chemicals and salts from de-icing agents applied on sidewalks, driveways, and parking areas.
- Oil, grease, PAHs, tire rubber-derived chemicals and other toxic chemicals from roads and parking areas used by motor vehicles.
- Bacteria and nutrients from pet wastes and faulty septic systems.
- Metals (arsenic, copper, chromium, lead, mercury, and nickel) and other pollutants from the pesticide use in landscaping and agriculture, roof runoff, decay of building and other infrastructure, and particles from street and tire wear.
- Atmospheric deposition from surrounding land uses.
- Metals, PAHs, PBDEs, and phthalates from roof and industrial runoff.
- Erosion of sediment and attached pollutants due to hydromodification.

The full presence of contaminants throughout the action area is poorly understood, but the concentration of many contaminants increases in downstream reaches (Fuhrer 1996; Johnson et al. 2013; Morace 2012). The fate and transport of contaminants varies by type, but are all determined by similar biogeochemical processes (Alpers et al. 2000b; Alpers et al. 2000a; Bricker 1999). After deposition, each contaminant typically processes between aqueous and solid phases, sorption and deposition into active or deep sediments, diffusion through interstitial pore space, and re-suspension into the water column. Uptake by benthic organisms, plankton, fish, or other species may occur at any stage except deep sediment, although contaminants in deep sediments become available for biotic uptake when re-suspended by dredging or other disturbances.

Climate Change

The environmental baseline includes the projected effects of climate change for the time period commensurate with the effects of the proposed action. Mauger et al. (2015) predict that circulation in PS is projected to be affected by declining summer precipitation, increasing sea surface temperatures, shifting streamflow timing, increasing heavy precipitation, and declining snowpack. While these changes are expected to affect mixing between surface and deep waters within PS, it is unknown how these changes will affect upwelling. Changes in precipitation and streamflow could shift salinity levels in PS by altering the balance between freshwater inflows and water entering from the North Pacific Ocean. In many areas of PS, variations in salinity are also the main control on mixing between surface and deep waters. Reduced mixing, due to increased freshwater input at the surface, can reduce phytoplankton growth, impede the supply of nutrients to surface waters, and limit the delivery of dissolved oxygen to deeper waters. Patterns of natural climate variability (e.g., El Niño/La Niña) can also influence PS circulation via changes in local surface winds, air temperatures, and precipitation.

PS Chinook salmon and PS steelhead were classified as highly vulnerable to climate change in a recent climate vulnerability assessment (Crozier et al., 2019). In estuarine environments, the two greatest concerns associated with climate change are rates of sea-level rise and temperature warming (Wainwright and Weitkamp 2013; Limburg et al., 2016). While the effects of climate change-induced ocean acidification on invertebrate species are well known, the direct exposure effects on salmon remain less certain (Crozier et al. 2019).

The effects of sea level rise are expected to vary across the Puget Sound seascape. As described in Mauger et al. 2015,

> "Sea level rise is projected to expand the area of some tidal wetlands in PS but reduce the area of others, as water depths increase and new areas become submerged. For example, the area covered by salt marsh is projected to increase, while tidal freshwater marsh area is projected to decrease. Rising seas will also accelerate the eroding effect of waves and surge, causing unprotected beaches and bluffs to recede more rapidly. The rate of sea level rise in PS depends both on how much global sea level rises and on regionally-specific factors such as ocean currents, wind patterns, and the distribution of global and regional glacier melt. These factors can result in higher or lower amounts of regional sea level rise (or

even short-term periods of decline) relative to global trends, depending on the rate and direction of change in regional factors affecting sea level."

Regional and local climate models have increased their utility in recent years by providing down-scaled projections of sea level rise within Puget Sound. The Climate Impacts Group (CIG) at the University of Washington has produced one such model. Using the high greenhouse gas scenario, Padilla Bay has a 50% chance of 0.7 feet sea level rise within 25 years (2050), and a 50% chance of 1.2 feet sea level rise within 50 years (2075) (Figure 6). Seemingly inconsequential, small sea level elevation rises can have significant impacts to infrastructure and low gradient landscapes, including No Name Slough (Figure 7).

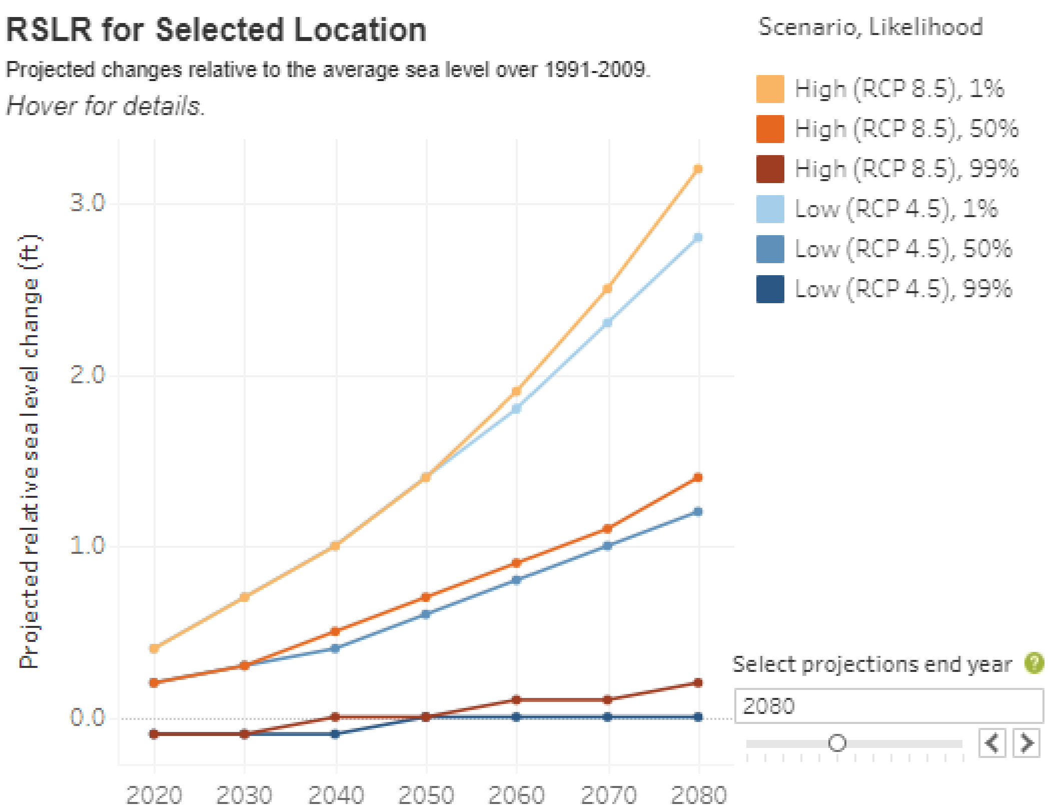

Figure 6. Sea level rise projections through 2080 using high and low greenhouse emission models (CIG 2024)[18].

[18] https://cig.uw.edu/ Accessed April 2024.

Figure 7. Padilla Bay side of No Name Slough with current and approximate future high tide elevations as projected using a 50% chance of occurrence from CIG models using high greenhouse gas scenarios (CIG 2024).

Skagit Bay and Padilla Bay

The Skagit River has lost extensive estuarine habitat to agricultural and residential development (Collins et al. 2003). Beginning in the 1860s, diking, ditching, and filling of the Skagit River delta reduced estuarine habitat from 11,483 ha to 3,118 ha by 1991 (Collins et al. 2003; Beamer et al. 2005). Additionally, much of the remaining Skagit tidal delta habitat has been disconnected from floodplain and tidal processes, largely through the construction and maintenance of dikes and roads. Approximately, 73 percent of the Skagit tidal delta has been isolated from floodplain and tidal processes, and 24 percent of the Skagit Bay shoreline has been armored to protect agricultural and residential land uses (Greene and Beamer 2011).

Padilla Bay is shallow and flushes most of the water into Puget Sound each day. Thus, residence time for water entering the bay is low. The bay is well-mixed, due to the large tidal prism, shallow depth, and moderately low freshwater inflow (Bulthuis, 2013). Four major freshwater tributaries (Joe Leary Slough, No Name Slough, Little Indian Slough, and Big Indian Slough) drain into Padilla Bay. In the early 1800s, much of the Padilla Bay watershed was lowland marsh area, including much of the Joe Leary Slough watershed identified on old maps as Olympia Marsh (Skagit County 2017; USCGS 1886; McCarthy 2020). These wetlands were drained by using existing sloughs and adding drainage ditches to produce farmland. Beyond the drainage of these wetlands, the primary change in the Padilla Bay watershed was the construction in the late 19th century of a sea dike along several miles of the southeast shore of Padilla Bay. This dike cut off hundreds of acres of shallow bay area which was then converted to farmland. This area is now drained by Big Indian, Little Indian, and No Name Sloughs (Skagit County, 2017). Padilla Bay drains about 23,000 acres of freshwater, most of which is agricultural. Nearly all freshwater emptying into Padilla Bay is from agricultural watercourses, including No Name Slough. Padilla Bay is about 11,000 acres and contains nearly 8,000 acres of eelgrass, which provides a rich community of nursery habitat for salmon, crab, perch, flatfish and herring. Padilla Bay has one of the largest contiguous stands of eelgrass along the Pacific Coast of North America (Bulthuis, 1996). A portion of the action area is within the Padilla Bay National Estuarine Research Reserve (NOAA 2024b). Padilla Bay is an "orphaned" estuary of the Skagit River (NOAA and Ecology 1980) where the bay is composed of a complex suite of estuarine straits and bays that receive fresh water from the Skagit, Nooksack, and Fraser rivers as well as numerous small coastal streams, sloughs, and rivers (Bulthuis 1996). Juvenile Chinook salmon are known in Padilla Bay and the adjacent Swinomish Channel (Beamer et al. 2007; and Rice et al. 2011). Chinook salmon caught in Padilla Bay sampling efforts indicate that most juveniles originate from the Skagit River (Rhodes et al. 2006). Beamer et al. (2013) reported that Chinook salmon fry use small streams and their confluences in the Whidbey Basin when not blocked by culverts and other fish passage barriers.

In summarizing estuarine habitat conditions of the Skagit River, the Washington State Conservation Commission (Smith 2003) found that distributary channels (channels that branch from the mainstem and drain into the estuary) were historically numerous, and wetland complexes covered more than half of the Skagit River delta resulting in a large amount of land in contact with saltwater (Bortleson et al. 1980; Collins and Montgomery 2001). From the 1860s until 1951, side channel and slough habitat decreased by about 90 percent in the Skagit Delta (Collins 2000). Prior to human impacts, blind tidal habitat comprised an estimated 20,386 acres while riverine tidal wetlands covered about 10,378 acres in the Skagit and Samish deltas for a total of 30,765 acres (Collins and Montgomery 2001). By the end of the 19th century, dikes had isolated most of the Skagit wetlands and by the mid-20th century, numerous distributary channels had been closed off (Collins and Montgomery 2001). As early as 1886, No Name Slough had been isolated from Padilla Bay by a dike (USCGS[19]). The Skagit basin has lost approximately 72% of historic estuarine delta habitat, including a loss of 68% of estuarine emergent habitat, 66% of transitional estuarine forested habitat, 84% of riverine tidal habitat, and 75 percent of its distributary channel (Beamer, et al. 2002a; Collins and Montgomery 2001; Beechie et al. 2001). Many channels were converted to ditches that drain farmlands and are no longer accessible to salmonids at their upper ends, and more than 100 miles of drainage ditches exist in the Skagit delta (Phinney and Williams 1975). In addition, much of the land isolated by dikes has been denuded of vegetation, ditched, dredged, or filled, resulting in a considerable loss

[19] https://riverhistory.ess.washington.edu/tsheets/framedex.htm. The U. S. Coast Survey, renamed as the U. S. Coast & Geodetic Survey (USCGS) in 1878, mapped the Puget Sound nearshore at a reconnaissance level in the 1840s, and then at a more detailed scale (1:10,000 and 1:20,000) in the following decades. The agency created two map series: topographic sheets, commonly referred to as "T-sheets, concentrated on intertidal and supratidal areas, and hydrographic sheets, or "H-sheets," showed soundings. The maps available from this site are the earliest detailed (1:10,000 or 1:20,000 scale) T-sheets for the Puget Sound nearshore.

and conversion of wetland, riparian, and aquatic habitat. For example, historical sources indicate the eastern shore of Padilla Bay, including No Name Slough, once included marsh habitat with aquatic vegetation (Figure 8).

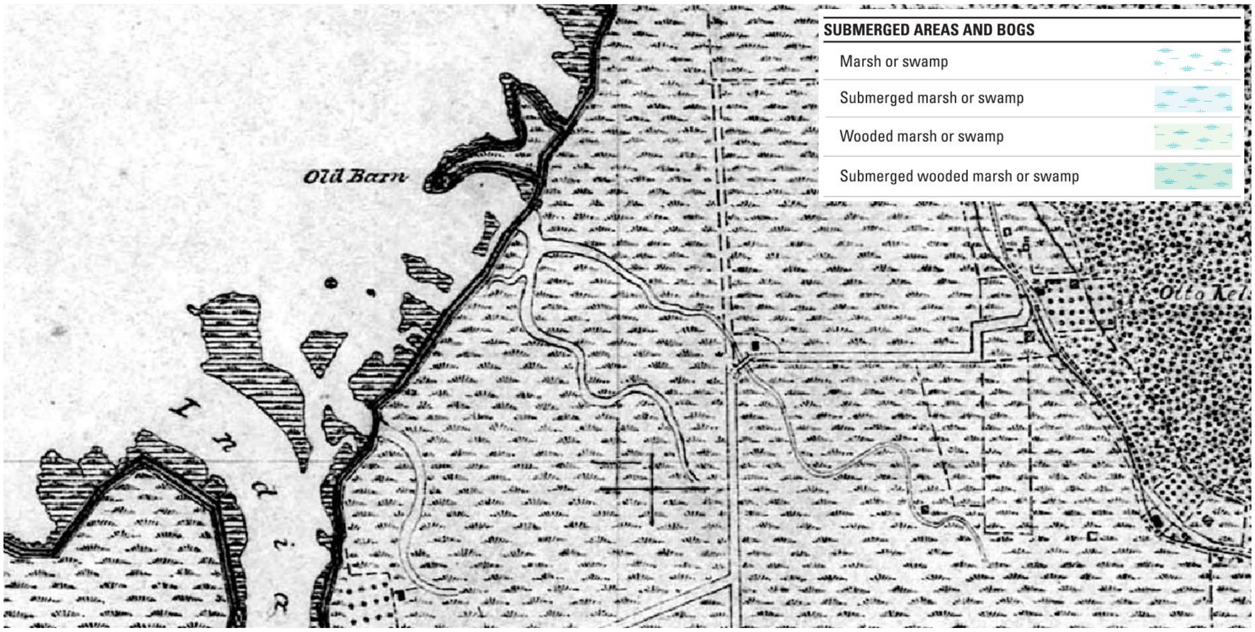

Figure 8. 1886 USCGS map of the eastern shore of Padilla Bay and No Name Slough. A dike is apparent along the shoreline with marsh vegetation present bayward and landward of the dike (USCGS). The historic presence of marsh vegetation supports the restoration potential of No Name Slough and adjacent waterways.

Today, much of the Skagit River estuary and delta has been converted from aquatic habitat to farmland and other uses through the development of extensive dike and levee systems (Table 8). In addition to the widespread loss of estuarine/delta habitat, blind channels, which are preferred habitat for juvenile Chinook, have been reduced by an estimated 94.6 percent (2,765.3 acres) (Beamer et. al. 2005). The net loss of edge and blind channel habitat preferred by rearing Chinook is an estimated 87.9 percent.

Table 8. Loss of Skagit Delta for each Habitat Type (Beamer et al. 2005).

	Current Acres	Historic Acres	Loss
Riverine Tidal	3,578	21,797	84 percent
Estuarine Forested Transition	5,916	17,213	66 percent
Estuarine Emergent Marsh	12,219	34,315*	68 percent
Total	20,601	73,333	72 percent

* Includes the 207 acres affected by the tidegates proposed for replacement at No Name Slough (WWAA et al. 2008).

While a substantial amount of estuarine habitat has been lost or rendered inaccessible, remaining accessible habitats within the estuary have also been degraded from a lack of LWD, lost riparian vegetation, and hydromodifications (i.e., shoreline armoring of the waterway), all of which degrade rearing habitat for juvenile Chinook salmon (Skagit Watershed Council 1999; Dethier et al. 2017). Habitat volume within some remaining tidal channels of the Skagit estuary has also been reduced. Historic diking of upper reaches of tidal channels reduced the tidal prism for channel reaches downstream, and this loss of tidal energy continues to cause a decrease of channel size and depth through sediment redistribution (Hood 2004). As sediment redistributes, channels get shallower, leaving less habitat for Chinook salmon to occupy and more areas dewatered during low tides.

With the extensive hydromodification of the historic Skagit Estuary, it has been suggested that sediment that historically deposited on the now inaccessible floodplain deposits (also termed progradation) within Skagit Bay, now creates shallow areas increasing estuarine habitat outside of existing dikes that compensates for habitat loss. Recent analysis of the Skagit estuary contradicts this hypothesis; in two analyses that accounted for accretion, net habitat loss of estuarine habitat near Wiley Slough was 174 acres, and 102 acres near the North Fork channel (Hood 2004). Since 1956, Hood (2005) estimated that the Skagit delta is prograding at approximately 4.1 acres per year near the North Fork of the delta, and losing an average of 0.74 acres per year in the South Fork. In total, a net increase of 168 acres has occurred. Conversely, in an analysis of the previous 15 years, Hood (2005) estimated that the North Fork region is prograding at roughly the same rate (average of 3.5 acres per year), and the South Fork area showing an average loss of 6.5 acres per year which is a net loss of 46 acres since 1991. An avulsion occurred in the North Fork in 2014 which has likely increased the progradation in this area. Marine currents move sediment from the Skagit Delta, slowing down or halting extensive progradation (Bortleson et al., 1980).

Smith and Manary (2004) summarized water quality in the estuary, as degraded. In addition to the loss of connectivity caused by dikes, water quality conditions were rated as poor for many of these sloughs (Smith 2003). Warm water temperatures and low dissolved oxygen levels have been recorded in Hall, Browns, Dry, and Wiley Sloughs, particularly in the summer months (Entranco 1993). Phosphorus and nitrogen levels were also high in each of these sloughs (Entranco 1993). Mayer and Elkins (1990) observed herbicide runoff in several sloughs of Padilla Bay following a rain event. Following rainfall in 1987, dicamba was found in all slough and Bay water samples at concentrations ranging from 10 to 160 µg/liter, and in 3 of the slough sediment samples at concentrations ranging from 5.8 to 17.1 µg/g. Similarly, 2,4-D was found in 9 slough water and 1 Bay water samples at concentrations ranging from 0.1 to 1.1 µg/liter (Mayer and Elkins (1990). High levels of fecal coliform bacterial contamination are found in Padilla Bay. The contamination is affecting beneficial uses in the area, such as shellfish harvesting and recreation. Several water bodies in eastern Padilla Bay and its watershed are included on Ecology's 303(d) list of impaired waters. On the list of impaired waters are parts of Padilla Bay, Joe Leary Slough, No Name Slough, Indian Slough, and Big Indian Slough. Additional water quality parameters of concern in the sloughs include DO, pH, and temperature (Washington Department of Ecology 2016). No Name Slough is on the 303(d) list for fecal coliform, dissolved oxygen, pH, and temperature (McCarthy 2020). The causes for the water quality problems in the Sloughs are thought to be low flows, non-point pollution, loss of riparian vegetation, loss of wetland habitat, and absence of flushing and circulation due to presence and maintenance of dikes and levees.

Tidal Channels in Puget Sound

Connectivity within nearshore and estuarine habitats has been lost and compromised. Smith and Manary 2004 reported that over 125 tidegates, pump houses and floodgates regulated drainage within the Skagit estuary. In recent years, active restoration efforts, including dike setbacks and tidegate removals have reduced the number of these structures.

Tidal channels of sloughs in coastal deltas can be important habitats for salmonids but are often highly modified by human activities. Connectivity between tributary creeks and mainstem channels is often constrained by structures such as dikes and floodgates, designed to protect urban and agricultural areas from flooding. Tidegates can diminish habitat quality and block fish from accessing tidal creeks (Seifert and Moore, 2018). Tidegates may impact fishes in two main ways: altering water quality and restricting fish passage (Kroon and Ansell 2006). First, tidegates can alter water quality by restricting tidal exchange (Raposa and Roman 2003; Ritter et al. 2008). Tidegates are associated with hypoxic dead zones due to eutrophication in the stagnant upstream habitats (Portnoy 1991; Gordon et al. 2015). Impounded water in tidal creeks also tends to have higher concentrations of nutrients, fecal coliforms, and heavy metals, as well as high turbidity and siltation rates (Giannico and Souder 2004; Portnoy and Allen 2006). Second, when closed, tidegates physically restrict fish passage, impeding migratory fishes from entering or leaving tidal creeks (Bass 2010; Doehring et al. 2011; Wright et al. 2014).

During their juvenile migration from freshwater to marine habitat, Chinook salmon may rear for prolonged periods in subsidiary and blind channel networks that connect mainstem estuarine channels with wetlands (Congleton et al. 1981; Simenstad 1983; Healey 1991). These channels are often intertidal, requiring twice-daily emigration from wetland areas and redistribution of salmon across large stretches of habitat as channels flood and drain with the tide (Rozas 1995; Gibson 2003). Despite these tidal emigrations, individual Chinook salmon may return to particular wetland channels for days to months, moving into flooded channel networks during high tides and retreating to subtidal habitats during low tides (Congleton et al. 1981; Levy and Northcote 1982; Shreffler et al. 1990). Salt marsh habitats provide productive feeding habitats for juvenile salmon (Levy and Northcote 1982; Simenstad et al. 1982; Shreffler et al. 1992) and have been described as potential predator refugia (Shreffler et al. 1992). Consequently, the condition of estuarine marsh habitat may be linked to life history diversity, productivity, and hence resilience of salmon populations (Bottom et al. 2005a, 2005b).

No Name Slough is located at the eastern shore of Padilla Bay. The tidegates drain the slough to the west and southwest, which exposes the shoreline to six to eight miles of fetch. The associated wind carries woody debris to the current armored shoreline which blocks the deposition of woody material from forming beach wrack, productive habitat for juvenile salmonids (Dethier et al. 2016). The habitat immediately waterward of the shoreline is largely composed of mudflat. At low tide, the mud flat is exposed and forms a shallow gradient between the base of the shoreline armoring and eelgrass (*Zostera marina and Z. japonica*), which dominates the substrate between the lower intertidal and subtidal areas of Padilla Bay and provides high quality habitat. At high tide, the area immediately bayward of the shoreline armoring steeply deepens, forming poor habitat conditions for juvenile salmon. The steepened shoreline lacks cover from predators and has reduced prey availability due to reduced riparian vegetation and beach wrack.

Landward of the tidegates, the habitat is mostly composed of hardened dikes and slough channels. The vegetation along the dikes is managed with chemicals or mechanical efforts to minimize riparian growth. The slough channels are devoid of habitat features, such as large wood, which might otherwise be used as cover from predators. Water temperature is elevated in No Name Slough (McCarthy 2020). Excessive sediment runoff from agriculture fields likely are responsible for the high turbidity observed during winter (Skagit Conservation District 2005). Juvenile coho salmon have been observed upstream of the slough in No Name Creek (Dugger 2000, Salmonscape 2024), so some fish passage and rearing in the basin has occurred.

2.4.1 Distinguishing Baseline from Effects of the Action

As described in more detail in Section 2.5 below, the effects of an action are the consequences to listed species or critical habitat caused by the proposed action and are reasonably certain to occur. In contrast, the environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area without the consequences caused by the proposed action (50 CFR 402.02).

Distinguishing baseline from effects of the proposed action for new structures is relatively straightforward. Differentiating these effects in repair or replacement projects requires more explanation. For this consultation, we must distinguish what impacts from the existing structure are properly attributed to the baseline compared with what future impacts are consequences of the proposed action. At its most basic, a repair or replacement project at least extends the life of the part of the structure being repaired or replaced. The impacts of part or all of the structure for the duration of that new life that would not occur in the absence of the USACE’s discretionary decision to issue the permit are considered consequences of the action. We explain additional nuances below.

When the USACE originally permits a structure, or a part of a structure, there is no "end date" on the permit that would require the future removal of that structure, or the piece of the structure. However, USACE general condition 2 at 33 CFR Part 325, Appendix A, and Nationwide Permit General Condition Number 14, require permittees to maintain authorized structures in good condition. Based on our experience with hundreds of consultations, to facilitate the existence of a permitted and structurally intact structure into perpetuity, regular maintenance will be necessary to keep that structure in the required good condition.

The expected issuance of future permits to facilitate maintenance work on the structures that are part of this proposed action allows us to make reasonable assumptions about the maximum amount of time certain types of structures will exist before the owner will seek a new USACE permit. The maximum expected number of years before another USACE permit will be needed to perform maintenance (hereafter, useful life period), as explained next, allows NMFS to limit our analysis to those expected time frames. In this case, NMFS assumes that repaired and replaced structures will have a maximum "useful life" of 50 years for shoreline armoring and the concrete tidegates before requiring an additional USACE permit to maintain their structural integrity.

Sometimes there is an increment of future impacts stemming from the existing structures that we consider as part of the environmental baseline. Specifically, we evaluate whether existing structures that are part of a proposed action could persist in the environment and cause the same effects for some additional years left of the structure's *original* useful life. Empirical studies on the useful life of rock revetment on marine shorelines are uncommon. Revetment life span may range from 30 years (McDonnel et al. 1996) to 50 years (Sanitwong-Na-Ayutthaya, 2023). Maintenance costs are a significant and ongoing expense when a hard armoring is selected. These costs are ongoing for the life of the structure and are therefore likely to result in significant levels of investment through a project's lifetime. However, periodic maintenance of revetment rocks require regular maintenance by adding new rocks every 5 -10 years to achieve a design life of 50 years (Sanitwong-Na-Ayutthaya, 2023). Here, the submitted project package did not speak to the current condition of the dike. Based on a review of the comments received on the Draft Opinion, and materials submitted by the District and the Corps, we have determined that there could be remaining life left in the armoring and so removal credit is reasonable. We note that the tidegates themselves appear to be failing and in need of immediate repair or replacement (based on the District's representations to the Court, their motion for a preliminary injunction, and the fact that one tidegate has already failed and has been partially removed and the area filled with material). In addition, the BA indicates that removal of the surrounding riprap will be necessary to facilitate those repairs: as part of the construction step involving removal of the two 4-foot-wide round culverts and tidegates that drain No Name Slough, to Padilla Bay, "excavated material, including riprap located on the seaward side of the dike, will be temporarily stockpiled" (page 8). The construction steps for removal of the northern culverts and tidegates include "excavate dike" and "the dike will be rebuilt with clean clay" (page 9). Together this would suggest the old riprap has no remaining useful life because it is integrated and integral to the proper functioning of the new tidegate. That would weigh in favor of giving no credit for any remaining life. Nevertheless, for the reasons mentioned above, NMFS has assumed that the parts of the structure/riprap being replaced has 10 years of useful life remaining, and therefore acknowledged commensurate credit for removing the structure early/before the end of its useful life. This is reflected in our analysis and Nearshore Conservation Calculator output. Utilizing a rebuttable presumption that a structure has 10 years of life before it would need a repair to keep it in good working order is consistent with assumptions made in the Salish Sea Nearshore Programmatic Consultation (NMFS 2022c) and other similar consultations. See, e.g., (NMFS 2020a, NMFS 2021, NMFS 2022b).

Notably, NMFS does not consider the theoretical, possible future degradation of these existing structures when evaluating the consequences of this action (what would not occur but for the proposed action and is reasonably certain to occur) for two main reasons. First, NMFS acknowledges if the owner of an existing nearshore, in- or overwater structures ceased to perform any maintenance and essentially abandoned the structure, there could be multiple scenarios relative to how that structure would persist and degrade in the marine shoreline environment. The range of potential outcomes is exponential, to the point it is not reasonable to assume them all, nor is there currently enough data or analysis that would support such an evaluation. In general, for scenarios where structures are left to degrade beyond their useful life, we acknowledge that complete degradation could take years in some cases. Further, the range of possible scenarios could result in impacts associated with a degrading structure over time would be both negative (e.g., decomposing creosote impacts to water quality) and positive (e.g., overwater cover is no longer obstructing migration or a tidegate no longer precluding habitat forming processes). This could also mean that at some point, the structure would fall out of compliance with the USACE original permit, or state or local permits). Failure to maintain nearshore, in- and/or overwater structures is not unheard of (Patterson et al 2014, King County 2019). However, there is also a preponderance of evidence, including the proposed action being evaluated in this Opinion and the thousands of redevelopment consultations that have occurred with the USACE since salmon were listed, that demonstrate that owners of nearshore, in- and overwater structures do at some point in time apply for USACE permit to keep the structure functioning before the structure falls into a less-than useful state. As the proposed applicant has demonstrated a desire to maintain its structures by applying for a USACE permit, and in light of the USACE's own requirements that the structures be maintained in a safe and "good" condition, see General Condition 2 at 33 C.F.R. Part 325, Appendix A, and Nationwide Permit General Condition Number 14, NMFS assumes that it is reasonably likely that regular maintenance will occur, and this structure will not be left to degrade. For these reasons, we appropriately decline to consider a range of possible outcomes that might occur absent the proposed action.

Second, even if we were to consider what might happen to a structure absent the proposed repair or replacement for the duration of its existence on the landscape, and such impacts should be attributed to the baseline, those impacts are still part of the calculus, they have just been moved out in time to occur after the new useful life (rather than any existing useful life). The basic consequence of the currently proposed action is to extend the life of the new tidegate and associated structures, including shoreline armoring. Any effects of possible degradation, instead of occurring now, will occur, if at all, after the new useful life expires. In that way, the potential effects that might occur should the applicant cease maintenance are still part of the baseline.

With this in mind, our analysis thus focuses on the future impacts of the proposed structure to be replaced for a new useful life of 50 years, along with any associated short-term and intermittent impacts, such as construction-related activities, or the beneficial removal of creosote piles, as consequences of the proposed action, which we discuss in the following section.

2.5 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 (see 50 CFR 402.02). 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 the factors set forth in 50 CFR 402.17(a) and (b).

As acknowledged in the TFI Agreement, projects as extensive as the proposed action involving replacement of tidegates, including those that require excavation of the tidegate and surrounding dike, extend the life of the facility. *See* WWAA et al. 2008, Section 4.1, differentiating between minor repairs, major repairs (which shall not include actions that require excavation of the dike to accomplish the repair, and would in any event use no more than 10 cubic yards or less of new rock to restore the original footprint of rock armoring), and replacements (requiring excavation of the dike to provide access to the tube/tidegate, and done to "extend the life of the gate facility or to restore impaired function," WWAA et al. 2008 at 4-3). Here, the proposed action requires excavation and the addition of approximately up to 73.6 cubic yards of new rock material to facilitate the replacement. Thus, this proposed action prolongs the life of the dike and associated tidegate, thereby preventing the recovery of habitat for a length of time commensurate with the new life of the structure.

We assume the new structure will last 50 years based on our best professional judgment and other information, including our work with RGP-6/Structure in Marine Waters Programmatic (NMFS 2016c), as well as input from consultants that regularly assist applicants through permitting processes (Ehinger et al. 2023, Appendix E). Depending on design, engineering, and materials, useful life periods could also be shorter or longer. We acknowledge that the Swinnomish Tribe have asserted that the structure would instead be in place for the next 100 years. We also acknowledge that a dike and tidegate has been at this location and operating for over 100 years (GeoEngineers 2022, at 2). However, for this consultation we applied a 50-year assumption. While we acknowledge that the structure may continue to exist and operate a longer period of time, we expect that it will require repairs to prolong its life within the next 50 years, consistent with our assumptions in other consultations as just described, and we expect that any additional life those repairs may cause, and their associated effects, will be evaluated at that time.

Our conclusion that the proposed action will prolong the life of the structure is supported by the materials provided by the District. For example, excavation of the existing dike is necessary and will occur as needed to access the work areas and facilitate construction activities (GeoEngineers 2022 at 10-12); a new sheet pile piece will be permanently installed to prevent seepage under the structure (email from Jenna Friebel to Kristen Murray on April 16, 2024), stabilizing the structure; the project anticipates adding approximately 73.6 cubic yards of new rock material, the dikes will be rebuilt and filled with clean clay, the dike will be regraded and strengthened using modern compacting requirements (engineering standards), and the tidegate will be made of materials including concrete and rebar. (e.g., GeoEngineers 2022, at 3, 6, 9, 13-14). These significant actions will prolong the life of the replaced structure by, we are assuming, 50 years (beyond the 10 years of remaining life), thereby precluding the return of the affected area to functioning habitat by an equal amount of time.

2.5.1 Effects on Listed Species

Effects on listed species is a function of (1) the numbers of animals exposed to habitat changes or effects of an action; (2) the duration, intensity, and frequency of exposure to those effects; and (3) the life stage at exposure. This section presents an analysis of exposure and response.

The project has temporary (related to construction) and enduring effects. Our exposure and response analysis identifies the multiple life stages of listed species that use the action area, and whether they would encounter these effects, as different life-stages of a species may not be exposed to all effects, and when exposed, can respond in different ways to the same habitat perturbations.

Temporary Effects

The temporary effects are caused by the construction activities necessary to carry out the proposed action, as well as some minor maintenance activities. For PS Chinook salmon and steelhead, these effects are caused by the relocation of fish following work area isolation, degradation of water quality, reduction of benthic prey, and construction noise. For SRKWs, temporary effects are loss of prey. Some future maintenance activities would also occur as a result of this proposed action and cause similar effects. These activities include minor maintenance of the shoreline armoring.

Period of Exposure to Temporary Effects

As described in Section 1.3 (Proposed Federal Action), all in-water work would occur only between July 16 and February 15 in any year the permit is valid. The minor future maintenance activities could occur at any time of the year.

Juvenile Puget Sound Chinook salmon generally emigrate from freshwater natal areas to estuarine and nearshore habitats from January to April as fry, and from April through early July as larger sub-yearlings. However, juveniles have been found in PS neritic waters between April and November (Rice et al. 2011). The work window avoids peak juvenile Chinook salmon presence from mid-February through mid-July, but does not fully avoid exposure in January through the first half of February. Additionally, a substantial percentage of Chinook salmon rear in Puget Sound without migrating to ocean areas (O’Neill and West 2009).

Juvenile PS steelhead primarily emigrate from natal streams in April and May, and appear to move directly out into the ocean to rear, spending little time in the nearshore zone (Goetz et al. 2015). However, steelhead smolts have been found in low abundances in the marine nearshore, outside of their natal estuary, between May and August (Brennan et al. 2004), which overlaps with the in-water work window. Juvenile steelhead will therefore be present in Puget Sound during the early part of the work window, July 16 through August, however, because they enter the Sound after a longer freshwater residency, they are larger and less dependent on nearshore locations where work is going to occur. The proposed work window would minimize overlap of temporary construction effects with the presence in nearshore habitat of juvenile PS steelhead in the action area, but will not avoid all exposure.

Juvenile Summary. Because exposure cannot be fully excluded by in-water work timing for juvenile salmonids, we evaluate other factors influencing potential presence of these fish, and if present, the potential duration of their exposure. Of these species, juvenile Chinook salmon have the longest period of nearshore association (Fresh 2006) and thus, although numbers are expected to be low at any given time, individual salmon are more likely to encounter the short-term construction effects in the intertidal and nearshore area. Some PS Chinook salmon juveniles would likely be present in the nearshore or estuary area behind the tidegate during future maintenance activities.

Adult salmonids. The presence of adult PS Chinook salmon and PS steelhead in PS overlaps with the proposed in-water construction window. Like adult PS Chinook salmon, adult PS steelhead occupy deep water, generally deeper than the location where the structures are proposed. Thus, we expect the direct habitat effects from the construction of the structures themselves to create little exposure or response among adult PS Chinook salmon and PS steelhead as they do not rely on the nearshore. However, some data suggests that up to 70 percent of PS Chinook salmon spend their adult period in Puget Sound without migrating to the ocean (Kagley et al. 2016), suggesting that most adult PS Chinook salmon will experience only the far-reaching effects such as sound from pile driving. Adult PS Chinook salmon and steelhead are unlikely to be exposed to any temporary effects caused by the future maintenance activities.

Southern Resident Killer Whales. Between the three pods that comprise this DPS, identified as J, K, and L, some members of the DPS are present in Puget Sound at any time of the year, though data on observations since 1976 have generally shown that all three pods are in Puget Sound June through September, which means that all are likely present in the designated work window that begins on July 16. As discussed in the Status section, the whales' seasonal movements are only somewhat predictable because there can be large inter-annual variability in arrival time and days present in Puget Sound from spring through fall. Late arrivals and fewer days present in Puget Sound have been observed in recent years. The likelihood of exposure to the temporary effects of construction or future maintenance is very low given the shallow depth of the water near the proposed project. Also, the implementation of a marine mammal monitoring plan and associated stop work protocols, during proposed construction, significantly reduces risk of exposure to any temporary effects.

Species Response to Temporary Effects

Response to Relocation

A small number of juvenile PS Chinook salmon are likely to be captured during work area isolation. PS steelhead are less likely to be in the isolated area, but there is some chance a few could be captured. No more than 100 juvenile Chinook salmon and PS steelhead are likely to be encountered. No adult Chinook salmon or steelhead are expected to be encountered during the isolation and relocation. Capturing and handling fish causes them stress, though they typically recover fairly rapidly from the process and therefore the overall effects of the procedure are generally short-lived (NMFS 2002). The primary contributing factors to stress and death from handling are differences in water temperatures (between the river and wherever the fish are held), dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18°C (64°F) or dissolved oxygen is below saturation. More impactful methods of fish capture, such as electrofishing, are not proposed for this action. Most of the relocated fish are expected to survive although a few could be injured during relocation and a very few could die during the process.

Response to Water Quality

In-water work and nearshore work (tidegate and culvert removal and replacement, excavation, construction, shoreline armoring, and future maintenance of armoring) would cause short-term and localized increases in turbidity and total suspended solids (TSS), potential declines in dissolved oxygen (DO), and temporary increases in pollutants such as PAHs. The area of elevated turbidity and TSS levels during construction could extend up to 200 feet radially[20] from the project location during construction, and would return to background levels shortly after the end of proposed construction (hours to days).

Fish Species Response

The effects of suspended sediment on fish increase in severity with sediment concentration and exposure time and can progressively include behavioral avoidance and/or disorientation, physiological stress (e.g., coughing), gill abrasion, and death—at extremely high concentrations. Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries, and identified a scale of ill effects based on sediment concentration and duration of exposure, or dose. Exposure to concentrations of suspended sediments expected during the proposed in-water construction activities could elicit sublethal effects such as a short-term reduction in feeding rate or success, or minor physiological stress such as coughing or increased respiration. Studies show that salmonids have an ability to detect and distinguish turbidity and other water quality gradients (Quinn 2005; Simenstad et al. 1988), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens 1991; Newcombe and Jensen 1996).

Despite being present during a portion of the work window, juvenile PS steelhead are not nearshore dependent and so are not expected to be in the shallow water in large numbers. Those present are expected to be only briefly in the area where elevated suspended sediment would occur (within a 200-foot radius to account for the point of compliance for aquatic life turbidity criteria) and to have strong capacity as larger juveniles to avoid areas of high turbidity. To the degree that there is a contemporary decrease in DO within the same footprint, because PS

[20] Because the project is near the shoreline, only half of an impact circle is in the water and would experience elevated turbidity. We used an area of a semicircle with a 200-foot radius for non-dredging projects to determine impacts associated with elevated turbidity and TSS levels.

steelhead are expected to have only brief exposure to the affected area, we do not anticipate a significant response to reduced DO. We accordingly consider their exposure to the temporary effects will not be sufficient to cause any injury or harmful behavioral response to juvenile PS steelhead.

Juvenile PS Chinook salmon are likely to be present during in-water construction activities and likely to be exposed to the temporary construction effects, most notably elevated levels of suspended sediment. The proposed minimization measures (i.e. only working in the dry) indicate that TSS levels will be only slightly elevated near the construction area and only during tidal inundations of the site during the project and during the first tidal inundation after completion of the project. Turbidity and TSS levels would return to background levels quickly and be localized to the in-water construction areas (200-foot radius turbidity mixing zone). Again, decreased DO is expected to be contemporaneous with and in the same footprint of the suspended sediment. While juvenile PS Chinook salmon are likely to encounter these areas, they can detect and avoid areas of high turbidity, and exposure is expected to be brief. Thus, duration and intensity of exposure of juvenile PS Chinook salmon is also unlikely to cause injury or a harmful response.

The area in which benthic forage base is temporarily diminished by disturbed substrate owing to the proposed project is very small, and because benthic prey recruits from adjacent areas via tides and currents, the prey base can re-establish in a matter of weeks. We expect only the cohorts of PS Chinook salmon and PS steelhead that are present in the action area to be exposed to this temporary reduction of prey, and we expect that because prey is abundant in close proximity, feeding, growth, development and fitness of the individuals that are present during this brief habitat disruption from construction would not be affected. Therefore, we consider the temporary effects on any juvenile PS Chinook salmon and PS steelhead in the action area to be unlikely to cause injury to individual fish.

SRKW Response

As noted above, implementation of a marine mammal monitoring plan and associated stop work protocols during proposed construction significantly reduces risk of exposure to any temporary effects. We do not expect SRKWs to be exposed to elevated turbidity or reduced DO.

Response to Construction Noise

Fish Species Response

The proposed No Name Slough project includes pile driving activities, two piles are proposed for removal by vibratory pile driving and sheet piles will be installed and partially removed. Vibratory pile driving can generate noise levels that fish detect and respond to, including above the 150 Db behavioral threshold but well below the thresholds for physical injury (Erbe and McPherson 2017). We assume that future maintenance will not require pile driving. Fish may exhibit behavioral responses to vibratory driving.

Pile driving can cause high levels of underwater sound. This noise from impact pile driving can injure or kill fish and alter behavior (Turnpenny et al. 1994; Turnpenny and Nedwell 1994; Popper 2003; Hastings and Popper 2005). However, only vibratory driving is proposed. Death from barotrauma can be instantaneous or delayed up to several days after exposure. Even when not enough to kill fish, high sound levels can cause sublethal injuries. Fish suffering damage to hearing organs may suffer equilibrium problems, and may have a reduced ability to detect predators and prey (Turnpenny et al. 1994; Hastings et al. 1996). Hastings (2007) determined that a cumulative Sound Exposure Level (cSEL) as low as 183 dB (re: 1 μPa2-sec) was sufficient to injure the non-auditory tissues of juvenile spot and pinfish with an estimated mass of 0.5 grams.

Though pile removal at No Name Slough will involve only vibratory pile driving and no direct mortality is expected, adverse effects on survival and fitness can occur even in the absence of overt injury. Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a temporary threshold shift), decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996). Popper et al. (2005) found temporary threshold shifts in hearing sensitivity after exposure to cSELs as low as 184 dB. Temporary threshold shifts reduce the survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success.

We cannot predict the exact number of individual fish that will be exposed because of high variability in species presence at any given time. Furthermore, not all exposed individuals will experience adverse effects. We are reasonably certain that some PS steelhead and PS Chinook salmon will experience sublethal effects, such as temporary threshold shifts, or behavior responses to underwater noise for each of the projects that includes pile driving.

The above-discussed criteria specifically address fish exposure to impulsive sound. Stadler and Woodbury (2009) make it clear that the thresholds likely overestimate the potential for impacts on fish from non-impulsive sounds (e.g., vibratory pile driving). Non-impulsive sounds have less potential to cause adverse effects in fish than impulsive sounds. Impulsive sources cause short bursts of sound with very fast rise times and the majority of the energy in the first fractions of a second. Whereas, non-impulsive sources cause noise with slower rise times and sound energy that is spread across an extended period of time; ranging from several seconds to many minutes in duration. Regarding noise from boat motors, some fish species have been noted to not respond to outboard engines, others respond with increased stress levels, and sufficient avoidance as to decrease density (Whitfield and Becker 2014).

With regard to vibratory driving and noise from excavation and construction activities, the behavioral effects from anthropogenic sound exposure remains poorly understood for fishes, especially in the wild. NMFS applies a conservative threshold of 150 dB rms (re 1 μPa) to assess potential behavioral responses of fishes from acoustic stimuli. Fewtrell (2003) observed fish exposed to air gun noise exhibited alarm responses from sound levels of 158 to 163 dB (re 1 μPa). More recently, Fewtrell and McCauley (2012) exposed fishes to air gun sound between 147-151 dB SEL and observed alarm responses in fishes.

Work windows are generally designed to prevent work from occurring during peak presence of salmonids, but do not guarantee that exposure will not occur. Juvenile Chinook salmon will have the most exposure due to their extensive use of nearshore habitats. Adult Chinook salmon, adult and juvenile steelhead make little use of nearshore habitats, and will be exposed to injurious levels of underwater sound in very small numbers. During the in-water work window (July 16 to

February 15), all exposed PS Chinook salmon and PS steelhead individuals will be at least two grams, which reduces the likelihood of death.

SRKW Response

SRKWs are unlikely to be injured or disturbed by sound pressure generated by vibratory pile driving. NMFS uses conservative thresholds of sound pressure levels from broad band sounds that cause behavioral disturbance (160dBrms re: 1μPa for impulse sound and 120 dBrms re: 1μPa for continuous sound) and injury (for impulsive: peak SPL flat weighted 230 dB, weighted cumulative SEL 185 dB; for non-impulsive: weighted cumulative SEL 198 dB) (NMFS 2018). Per the best management practices listed in Section 1.3, NMFS assumes that the proposed project will have a Marine Mammal Monitoring Plan. Those criteria and the Plan are intended to ensure monitoring and stop-work on sighting of SRKW such that SRKW will not be exposed to pile driving that would result in disturbance or harm to any individual of this species.

Any potential reduction in prey for SRKWs (PS Chinook salmon) from construction noise, is extremely small, due to the application of work windows to avoid peak presence of this species at the juvenile life stage and the other reasons discussed above. As mentioned above, diet data suggest that SRKWs are consuming mostly larger (i.e., generally age 3 and up) Chinook salmon (Ford and Ellis 2006). Given the total quantity of prey available to SRKWs throughout their range, this short-term harassment of SRKW prey that results from the temporary construction effects is extremely small and not expected to cause injury to or disturb SRKWs.

Response to Water Quality Effects caused by Creosote Removal

Fish Species Response

The proposed action would remove creosote-treated piles. Creosote-treated piles contaminate the surrounding sediment up to two meters away with PAHs (Evans et al. 2009). The removal of the creosote-treated piles mobilizes these PAHs into the surrounding water and sediments (Smith 2008; Parametrix 2011).

Projects can also release PAHs directly from creosote-treated piles if any of the piles break during removal (Parametrix 2011). The concentration of PAHs released into surface water rapidly dilutes. Smith 2008 reported concentrations of total PAHs of 101.8 μg/l 30 seconds after creosote-pile removal and 22.7 μg/l 60 seconds after. However, PAH levels in the sediment after pile removal can remain high for six months or more (Smith 2008). Romberg (2005) found a major reduction in sediment PAH levels three years after pile removal contaminated an adjacent sediment cap.

Because they are shoreline-oriented and spend a greater amount of time within the action area, juvenile PS Chinook salmon would have the highest probability of exposure to PAHs as a result of creosote pile removal. Although we cannot discount the probability of adult and juvenile steelhead and adult PS Chinook salmon exposure, the risk is low. The removal of the piles will happen relatively quickly, and the amount of time any contaminants will be resuspended would be short. We expect increased PAHs in the water column and sediments will remain within the area of increased suspended sediment caused by the project within a short distance of creosote pile removal, and we do not expect fish to engage in avoidance behaviors within this area once suspended sediment from construction effects have dropped to baseline levels. Within three years after construction, the removal of the creosote-treated timber will begin to reduce PAH levels (Romberg 2005) and thus exposure of listed-fish, and exposure to PAHs at these sites would continue to decline over the long term. For these reasons, we do not expect any fish to be exposed to PAHs at levels that would cause injury or other adverse effects.

SRKW Response

The proposed removal of the piles exposes SRKW to contaminants indirectly through its food web (PS Chinook salmon). However, as explained above, the exposure would be minor and not expected to injure or kill any individual PS Chinook salmon or steelhead. Due to the low number of fish exposed to these contaminants, the proposed action would not cause a meaningful effect on SRKW.

Enduring Effects on Nearshore Habitat

The proposed action would cause negative impacts on nearshore habitat availability and function. Once repaired and replaced, the structures would be expected to remain in the aquatic environment for an additional 50-year useful life period. Thus, multiple cohorts of the multiple populations of PS Chinook salmon, PS steelhead, and SRKW would experience the effects of the long-term nearshore habitat modifications caused by the presence of the structure.

Nearshore Habitat Modifications due to Shoreline Armoring

The proposed replacement of 85 linear feet of armored shoreline (62 linear feet of large rock and 23 linear feet of vertical concrete structural support for the tidegate) in Puget Sound would extend the life of this armoring by 50 years. The effects that this structure exerts on habitat features and functions also would persist for the same duration. The impacts of hard armor along marine and estuarine shorelines are well documented. Armoring of the nearshore can reduce or eliminate shallow water habitats through the disruption of sediment sources and sediment transport. (Marine Shoreline Design Guidelines at 2-1 (Johannessen et al. 2014)). The proposed shoreline armoring is also expected to result in a higher rate of beach erosion waterward of the armoring from higher wave energy compared to a natural shoreline. This leads to beach lowering, increases in sediment temperature, and decreased SAV, leading to reductions in primary productivity and invertebrate density within the intertidal and nearshore environment (Bilkovic and Roggero 2008; Fresh et al. 2011; Morley et al. 2012; Dethier et al. 2016). Structures in the nearshore change the hydrodynamics of the waves washing up on the beach. Hard structures reflect waves without dissipating their energy the way a natural beach would, especially if vegetation is present. In addition to higher rates of beach erosion by increased wave energy, the proposed armoring is also expected to prevent input of sediment from landward of the dike, diminishing the supply of fine sediment. Shoreline armoring generally reduces the sediment available for transport by disconnecting the sediment source potentially causing loss of beach width and height as transport of material outpaces supply. This can occur at the site of the structure.

When nearshore physical processes are altered, there is also a shift in the biological communities. The effects of nearshore modification cascade through the Puget Sound food web.

The consequences can be seen in the population declines of a variety of species that depend on these ecosystems, from shellfish, herring, and salmon to SRKWs, great blue heron, and eelgrass. The number and types of invertebrates, including shellfish, can change; forage fish lose spawning areas; and juvenile salmon and forage fish lose the feeding grounds that they use as they migrate along the shore (Shipman et al. 2010). Native shellfish and eelgrass have specific substrate requirements and altered geomorphic processes can leave shellfish beds and eelgrass meadows with material that is too coarse or with too much clay exposed. Finer materials like gravel and sand provide important spawning substrate for sand lance and surf smelt. Therefore, a reduction to this substrate type within the intertidal and nearshore zone as a result of the proposed dike is expected to reduce potential spawning habitat availability and fecundity of both species of forage fish (Rice 2006; Parks et al. 2013), which are important prey species for salmonids.

As a result of deepening of the nearshore zone adjacent to shoreline armoring, as well as increased wave energy, the replaced shoreline armoring would also be expected to reduce SAV (Patrick et al. 2014), reducing cover for juvenile salmon. Salmonids are also affected by the loss of prey communities. When shoreline development removes vegetation, the loss of shading and organic material inputs can increase forage fish egg mortality (Penttila 2007). Surf smelt, for example, use about 10 percent of Puget Sound shorelines for spawning and many bulkheads are built in forage fish spawning habitat, threatening their reproductive capacity (Penttila 2007). A reduction in eelgrass could cause a reduction in potential spawning habitat for Pacific herring, another forage species for salmonids. Shoreline armoring can also physically bury forage fish spawning beaches when structures are placed in or too close to the intertidal zone. Besides being prey, a sometimes-overlooked benefit of forage fish abundance to salmonids is their use as a prey buffer for predation by marine mammals and piscivorous birds. Moore et al. (2021) found that the high abundance of age-1+ anchovy in the Puget Sound provided an alternative prey source for predators of outmigrating steelhead smolts, which resulted in an increase in smolt survival.

Shoreline armoring, located within the intertidal zone (below HAT) disrupts upper intertidal zone and natural upper intertidal shoreline processes such as accumulation of beach wrack (Sobocinski et al. 2010; Dethier et al 2016). This is an additional mechanism that reduces primary productivity within the intertidal zone and diminishes invertebrate populations associated with beach wrack (Sobocinski et al. 2010; Morley et al. 2012; Dethier et al. 2016). Reductions in forage from shoreline armoring then affect primary productivity and invertebrate abundance in both the intertidal and nearshore environments. Invertebrates are an important food source for PS Chinook salmon and for forage fish, prey species of salmonids.

Thus, the loss of material below the proposed shoreline armoring, together with the loss of upland sources of material from above the shoreline armoring and tidegates, over time, is likely to affect the migration and growth of juvenile salmonids (primarily PS Chinook salmon) by reducing the amount of available shallow habitat that juveniles rely on for food and cover, and by preventing access to habitat upland of these structures at high tides. It is also expected to increase predation on PS Chinook salmon by reducing SAV, an important source of cover for juvenile salmon. This in turn will reduce prey available for SRKWs. As described above shoreline armoring also lowers beaches, coarsens substrates, increases sediment temperature, and decreases beach wrack. This habitat degradation is expected to reduce the available prey, such as forage fish, for PS Chinook salmon.

In addition to these qualitative analyses, as indicated in the Analytical Approach section, we have also evaluated certain effects of the proposed action on the marine side of the shoreline armoring, including the tidegate with V1.6 of the Nearshore Calculator, released February 2024. The final output of the calculator is - 275 debits (-2.75 DSAYs[21]). As noted in the Analytical Approach section, this output of -275 debits is based on the following assumptions and inputs to the Calculator:

- The remaining useful life of the existing riprap armoring is 10 years;
- The useful life of the new tidegate and shoreline armoring structures is 50 years;
- Riparian plantings have a relatively low success rate over time, which is especially likely on the rip rap shoreline of Padilla Bay and No Name Slough; and,
- Two creosote piles will be removed, which will be disposed of at an approved upland facility.

Further details about our quantitative assessment of the enduring effects on nearshore habitat are set out in Appendices 1, 2, and 5.

Species Response to Shoreline Armoring

Fish Species Response to Enduring Effects of Shoreline Armoring

Juvenile Chinook salmon migrate along shallow nearshore habitats in Puget Sound. The proposed shoreline armoring would degrade nearshore habitat for an additional 50 years, affecting dozens of cohorts of PS Chinook salmon. Every juvenile PS Chinook salmon will encounter armored beaches during their out-migration. Shoreline armoring reduces several nearshore habitat values, including reduced feeding opportunity, increased predation risk, and lack of shallow habitat areas particularly during high tides.

Given that out-migrating PS Chinook salmon use shallow-water habitats for rearing, foraging, and migration, shoreline armoring would reduce growth and fitness of juvenile salmon during this phase of their life history. In turn, the aggregate impact of this disruption among individuals over each year that the proposed armoring is in place for its new 50-year useful life period will amount to an overall reduction in survival rate. The proposed action would reduce the quality of nearshore habitat, reducing the amount of prey available for juvenile salmonids. Adult Chinook salmon, adult and juvenile steelhead do not migrate along shallow nearshore habitats. As described above, the proposed shoreline armoring will not directly affect them. However, impacts on SAV and epibenthic communities from shore steepening, and sediment coarsening will affect adult and juvenile Chinook salmon and steelhead by reducing available forage. This would result in chronic reductions in abundance from each cohort of each affected population. The long-term effect of downward abundance would be an overall reduction in abundance, productivity, and spatial structure, of the affected PS Chinook salmon populations.

[21] Discounted Service Acre Years (DSAYs): Measure of change in habitat services provided over a specific duration of time to a set of target species within the Habitat Equivalency Analysis (HEA) method.

SRKW Response to Enduring Effects of Shoreline Armoring

The proposed action reduces the quality of nearshore habitat which in turn reduces the abundance of PS Chinook salmon, an important prey item for SRKW. When prey is scarce, SRKW likely spend more time foraging than when prey is plentiful. Increased energy expenditure and prey limitation can cause poor body condition and nutritional stress. Nutritional stress is the condition of being unable to acquire adequate energy and nutrients from prey resources and as a chronic condition, can lead to reduced body size of individuals and to lower reproductive or survival rates in a population (Trites and Donnelly 2003). During periods of nutritional stress and poor body condition, cetaceans lose adipose tissue behind the cranium, displaying a condition known as “peanut-head” in extreme cases (Pettis et al. 2004; Bradford et al. 2012; Joblon et al. 2014). This individual stress and diminished body condition of individuals would lead to an overall decline in the fitness of the species, while accounting for age and sex (Stewart et al. 2021). NMFS qualitatively evaluated long-term effects on the SRKW from the anticipated reduction in PS Chinook salmon. We assessed the likelihood for localized depletions, and long-term implications for SRKW survival and recovery, resulting from the proposed action presenting risks to the continued existence of PS Chinook salmon and reducing the ability for the ESU to expand and increase in abundance. In this way, NMFS can determine whether the reduced likelihood for survival and recovery of prey species is also likely to appreciably reduce the likelihood of survival and recovery of Southern Residents. Viability at the population level is a foundational necessity for PS Chinook salmon persistence and recovery.

Hatchery programs, which account for a large portion of the production of this ESU, may provide a short-term buffer, but it is unlikely that hatchery-only stocks could be sustained indefinitely. The loss of an individual PS Chinook salmon population could preclude the potential for the ESU level future recovery to healthy, more substantial numbers. The weakened ESU demographic structure, with declines in abundance, spatial structure, and diversity, will result in a long-term suppression, if not decline, in the total prey available to Southern Residents. In this consultation, the long-term effects are specifically: fewer populations contributing to Southern Residents’ prey base, spatial structure, resiliency of prey base, greater ESU-level risk relative to stochastic events, and diminished redundancy that is otherwise necessary to ensure there is a margin of safety for the PS Chinook salmon and SRKWs to withstand catastrophic events.

Differences in adult salmon life histories and locations of their natal streams likely affect the distribution of salmon across the SRKW’s geographic range. The continued decline and reduced potential for recovery of the PS Chinook salmon, and consequent interruption in the geographic continuity of salmon-bearing watersheds in the SRKW’s habitat, is likely to alter the distribution of migrating salmon and increase the likelihood of localized depletions in prey, with adverse effects on the SRKW’s ability to meet their energy needs. A fundamental change in the prey base is likely to result in SRKW abandoning areas in search of more abundant prey or expending substantial effort searching for prey in areas of depleted prey resources. This potential increase in energy demands should have the same effect on an animal’s energy budget as reductions in available energy, such as one would expect from reductions in prey. Any action that exacerbates this situation makes the risk incrementally worse and reduces the likelihood that SRKWs will have an adequate prey base.

Lastly, the long-term reduction of PS Chinook salmon is likely to lead to nutritional stress in the SRKW. Nutritional stress can lead to reduced body size and condition of individuals and can also lower reproductive and survival rates. Prey sharing would distribute more evenly the effects of prey limitation across individuals of the population that would otherwise be the case. Therefore, poor nutrition from the reduction of prey could contribute to additional mortality in this population. Because SRKWs are already stressed due to the cumulative effects of multiple stressors, and the stressors can interact additively or synergistically, any additional stress such as reduced PS Chinook salmon abundance likely have a greater physiological effect than they would for a healthy population, which may have negative implications for SRKW vital rates (mortality and fecundity) and population viability (e.g., NAS 2017). Intuitively, at some low Chinook salmon abundance level, the prey available to the whales may not be sufficient to allow for successful foraging, leading to adverse effects (such as reduced body condition and growth and/or poor reproductive success). This could affect SRKW survival and fecundity. For example, food scarcity could cause whales to draw on fat stores, mobilizing the relatively high levels of contaminants stored in their fat and potentially affecting reproduction and immune function (Mongillo et al. 2016). Increasing time spent searching for prey during periods of reduced prey availability may decrease the time spent socializing; potentially reducing reproductive opportunities. Also, low abundance across multiple years may have even greater effect because SRKWs likely require more food consumption during certain life stages, female body condition and energy reserves potentially affect reproduction and/or result in reproductive failure at multiple stages of reproduction (e.g., failure to ovulate, failure to conceive, or miscarriage, successfully nurse calves, etc), and effects of prey availability on reproduction should be combined across consecutive years.

Enduring Effects on Habitat Caused by the Tidegate

Estuary habitat in No Name Slough and surrounding floodplains is not designated as critical habitat for PS Chinook salmon, PS steelhead, or SRKW. However, impeding access to the habitat behind the tidegate, in the slough and in the surrounding floodplains for the new 50-year life of the structures would cause enduring effects on PS Chinook salmon, PS steelhead, and SRKWs. By blocking incoming tides, tidegates and associated shoreline armoring convert what would otherwise be marine wetlands to agricultural land with greater freshwater influence (and maintain it that way). The area directly in front of the tidegate could be considered nearshore or estuary habitat and has characteristics of both habitat types. In this analysis, some effects, particularly, those related to water quality, that would occur directly in front of the tidegate are considered effects on estuary habitat.

Estuarine Habitat Modifications Due to Tidegate Replacement

In Puget Sound, it has been estimated that 80% of estuary habitat has been lost to diking and land conversion (Simenstad et al., 2011; Brophy et al., 2019) with more than 90% of delta and riverine habitat isolated by dikes and other structures in the Skagit River delta (Collins and Montgomery, 2001). As is typical throughout PS deltas, the construction and maintenance of dikes to prevent tidal inflow, and the installation of tidegates to drain agricultural fields and stream flow from relict sloughs and distributary channels is spatially extensive (Greene et al. 2012). Tidegates are commonly equipped with hinged flap gates, which open during ebbing tides to allow ditch water to drain and close on rising tides to prevent saline flows back into the diked area farmland. Thus, without designs that hold the gate open, tidegates block fish passage at least 50% of the time. Additionally, juvenile salmon commonly move with the incoming tide to access nearshore habitats, which coincides with the closing of tide-driven flap gates. When flap gates open with the ebbing of the tide, the differential between water level escaping the ditch and the estuary can create velocity barriers for fish movement (Souder and Giannico 2020). Consequently, flap tidegates limit the passage of adult and juvenile fishes (Greene et al. 2012; Giannico and Souder 2005; Souder and Giannico 2020). Side-hinge tidegates may provide improved fish passage relative to top-hinge tidegates, however, the length of time that side-hinge gates are open is still dependent on the changing of the tides (every 6 hours on average). Thus, fish passage is still restricted by side-hinge tidegates approximately 50% of the time. Tidegates are effective in their intended purpose—blocking marine waters from inundating estuary areas. As a consequence, they are also effective fish passage impediments (Giannico and Souder 2005). As juvenile Chinook salmon rear along estuarine shorelines, in pocket estuaries and distributary channels for a month or more before migrating increasingly to deeper water of PS (Beamer et al. 2000), tidegates impede their growth and survival for several reasons, as discussed below.

Like all conventional tidegates, the proposed No Name Slough tidegate would close on incoming tides. Just as poorly designed dams and culverts delay or completely impede adult fish migration to spawning grounds, conventional tidegates reduce access to rearing habitat of juvenile Chinook salmon and steelhead, disrupt sediment routing, and adversely alter habitat and water quality parameters. Fish can access the slough during low and medium outgoing tides, but not while water is being pumped out. Coho salmon smolts have been observed rearing upstream of the slough in No Name Creek (Dugger 2000). Conventional tidegates severely limit fish abundance and species richness (Giannico and Souder 2005; NMFS unpublished data). The No Name Slough tidegate replacement project is expected to cause impaired fish passage for the next 50 years. The construction materials used to replace the failing system (HDPE culvert with a fiberglass tidegate) are expected to resist decay for many decades. As such, the replacement tidegate is expected to operate, with necessary maintenance such as removing debris, for 50 years.

Once replaced, the tidegates at No Name Slough will impair access to available habitat in No Name Creek. It is currently unknown if PS steelhead currently occupy No Name Creek, but coho salmon have been observed behind the tidegate, suggesting that salmonids can pass through the tidegate or otherwise access No Name Slough under certain conditions (Dugger 2000).

PS Chinook salmon passage within No Name Slough upstream of the tidegate is limited to ebbing (outgoing) tides when the tidegate flap is open. However, within estuarine habitats, juvenile Chinook do not readily migrate upstream during ebb (outgoing) tides. To the contrary, juveniles generally move with outflowing tides, as evidenced by numerous studies that have captured juvenile Chinook salmon in fyke nets as the tide recedes, and fyke net sampling protocol (Beamer et al. 2003; Greene et al. 2017). Even if some fish do migrate upstream, poor water quality draining from the gate may block or slow fish movement, velocities exiting the tidegate may be too great for juvenile Chinook salmon to surpass, and the tidegate and culvert is perched during some low tides, all leading to poor or impossible passage conditions for juvenile PS Chinook salmon. The fish that do pass through the tidegate will experience degraded habitat conditions as further explained below.

Fish Response to Loss of Estuary Habitat Quality Behind the Tidegate.

The proposed structure is expected to virtually eliminate tidal influence and hydraulic mixing from wave action upstream of (behind) the gate. The reduction of hydrologic flushing in turn would contribute to decrease the channel in width and depth from sediment deposition, and thus reduce the quantity of habitat preferred by juvenile PS Chinook salmon. As further discussed below, the replacement tidegate also causes altered sediment deposition that reduces habitat quantity. Sediment deposition, and the reduction of width and depth reduces channel habitat area, and dewaters the channel more frequently which in turn reduces habitat value as channel boundaries become less defined, and reduces the time of use by juvenile PS Chinook salmon. This reduces the condition of juvenile PS Chinook salmon.

Water quality parameters negatively affected by tidegates include salinity, dissolved oxygen, sediment, and temperature (Greene et al. 2017). The replacement tidegate project is expected to create conditions that reduce water quality. The static environment behind the tidegate can cause thermal loading. This results in growth of periphyton and planktonic algae that lead to reduced dissolved oxygen levels. Periphyton and planktonic algae are composed mainly of primary producers that, within static water bodies, can reduce oxygen levels as they decompose and respire, and at high densities, impede water movement (in turn making conditions more static) (Welch 1967) Reduced dissolved oxygen would adversely affect any juvenile PS Chinook salmon rearing behind the tidegate. Water with low dissolved oxygen will also discharge to habitat on outgoing tides during some (mid to late summer) juvenile Chinook rearing periods. In the latter portions of the outgoing tide, often the only water within these small channels is from the tidegate discharge. Because PS Chinook salmon recede into these channels on low tides (Groot and Margolis 1991; Healey 1980) there can be direct exposure to poor water quality. This exposure to poor water quality reduces the condition of exposed juvenile PS Chinook salmon.

Tidegates can alter temperature regimes in estuary areas behind the gate and in nearshore areas in front the gate. By restricting the normal bidirectional flow of water, tidegates create sharp transitions in water temperature (Bates 1999; Portnoy 1999; Portnoy and Giblin 1997; Portnoy et al. 1987). Abrupt changes in water temperature can impose barriers to fish movements (Jonsson 1991; Bakshtansky et al. 1993; Berggren and Filardo 1993; Kynard 1993; Russel et al. 1998; Bates et al. 1999). For example, the temperature behind a tidegate in Fisher Slough (a slough in the Skagit River delta) was 2.2°C warmer than the temperature immediately downstream of the tidegate (Beamer et al. 2014). A similar difference was observed in Blind Slough (a slough in Tillamook Bay, Oregon) where differences were 2 – 5°C warmer upstream of the tidegate than downstream. Juvenile salmon and steelhead are particularly vulnerable to disease, parasites, and poor competitive interactions in water with elevated temperatures (Reeves et al. 1987), which can form behind closed tidegates (Giannico and Souder 2005).

Growth of juvenile Chinook salmon has been determined to occur between 4.5 and 19.1°C (Armour 1991). In the Snohomish River, temperatures within two blind channels with tidegates were ‘potentially lethal’ during the latter portions of the Chinook salmon outmigrant season. The channels regulated by tidegates also had significantly more time within the “upper growth boundary” and “stressful” temperature ranges than the reference channel (Tonnes, 2007). The observed temperature range may lead to death of juvenile salmonids, depending upon the acclimation temperatures prior to exposure, as well as the duration of exposure, relative health of the fish, among other factors (McCullough 1999).

Estuarine temperature regimes can influence salmonid migration timing, feeding and growth, smoltification, predation avoidance, and resistance to parasites, disease, and pollutants (McCullough 1999). Juvenile Chinook within the Sixes River (Oregon) estuary grew less during periods when water temperatures frequently exceeded 18°C (Neilson et al., 1985). Because estuarine residency is associated with smoltification of salmonids, elevated temperatures can result in premature smolting, blockage of seaward migration, de-smoltification, shifts in emigration timing, and other stressors (McCullough, 1999). Elevated temperatures during the smolt phase have led to lowered survival of fish when subjected to seawater test-lowered survival is correlated with inability to osmoregulate due to impaired physiological status (Adams et al., 1973; Zaug and McLain 1976; Hoar 1988). Elevated temperatures behind tidegates may reduce the condition and growth of juvenile PS Chinook salmon.

Because tidegates prevent tidal flows moving upstream, the water behind the gates typically has lower dissolved oxygen, higher temperature, and lower salinity and pH. If no mixing of fresh and brackish waters occurs in these areas, the resulting abrupt change in water quality is stressful for fish and other organisms that migrate up- and/or downstream through tidegates. Gordon et al. (2015) found that dissolved oxygen (DO) was lower in gated streams than in reference systems, in turn the concentration of DO was lower above gates (in average 2.47 mg/L and as low as 0.08 mg/L) than below them and significantly lower than the comparable region at reference sites (8.41 mg/L). The hypoxic zone detected above the tidegates extended at least 100 m upstream. Optimum dissolved oxygen levels are typically near 8.0 mg/l, at reduced levels, such as 6.0 to 7.0 mg/l, swimming performance is reduced, and avoidance of the plume (if possible) may occur (Bjornn and Reiser 1991). Growth and food conversion efficiency reduction can occur at levels near 5.0 mg/l (Bjornn and Reiser 1991). Anoxic conditions created by tidegates have been associated with fish mortality events (Portnoy 1991). No Name Slough is listed in Ecology’s 303(d) list for low dissolved oxygen with recorded violations. Lower dissolved oxygen levels may reduce the condition and survival of juvenile PS Chinook salmon.

When closed, tidegates prevent the inundation of upland channels by salt water. Consequently, major differences in salinity develop between the estuary and delta sides of tidegates. Excluding salt water can lead to oxygen depletion in delta channel habitats. The operation of tidegates lowers the salinity of soils on the delta side of dikes, which lowers pH (increasing acidity) (Richardson and Vepraskas 2001) and in turn increases the mobilization of metals in the soil, including, iron, lead, aluminum, copper, silver, and cadmium (Anisfeld and Benoit 1997; Portnoy and Giblin 1997). The mobilization of metals such as iron and aluminum will kill many marsh plants, which can greatly alter invertebrate communities and reduce the prey and cover available to juvenile salmon and steelhead (Giannico and Souder 2005). As a result, replacement of the tidegate will reduce rearing and foraging opportunities of PS steelhead and Chinook salmon.

Fish Response to the Loss of Habitat Quality in Front of the Tidegate

As explained above, a tidegate and its operation cause effects on estuary habitat. Those effects in turn cause several negative downstream impacts on nearshore/estuary habitat in front of the tidegate. These effects are unique from, and in addition to, those caused by shoreline armoring. As tidegates block two-way flow, fine sediments fill upland channels instead of flushing to the estuary below (Bates 1999). Consequently, as sediments and detritus fill channels, they do not reach the estuary, reducing productivity (Roman et al. 1984).

Altered channel conditions and the interruption of natural sediment routing processes as a result of the proposed action is likely to cause high turbidity as water flows outward from the tidegate. The effects of suspended sediment on fish increase in severity with sediment concentration and exposure time and can progressively include behavioral avoidance and/or disorientation, physiological stress (e.g., coughing), gill abrasion, and death (at extremely high concentrations). Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries, and identified a scale of ill effects based on sediment concentration and duration of exposure, or dose. Exposure to concentrations of suspended sediments expected during the proposed in-water construction activities could elicit sublethal effects such as a short-term reduction in feeding rate or success, or minor physiological stress such as coughing or increased respiration. Studies show that salmonids have an ability to detect and distinguish turbidity and other water quality gradients (Quinn 2005; Simenstad et al. 1988), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens 1991; Newcombe and Jensen 1996).

Salinity differences may also exist across the tidegate (Giannico and Souder 2005). When the tidegate is closed freshwater pools on the upland side. As a result, a difference in salinity may exist between one side of the gate and the other. When the gate opens, pooled freshwater moves into the estuarine channel, a packet of fresher water that, through turbulence, mixes as it moves down the estuary. The speed of the salinity mixing, and the extent of the freshwater packet, is related to the type and size of the gate, the amount of freshwater pooled upstream, and the relative difference in salinity between fresh and brackish water in the area (Jay and Kukulka 2003). For salmonids, abrupt salinity changes in nearshore habitat may even cause osmotic shock that can result in juvenile mortality and delayed adult migration.

We cannot estimate the exact number of individuals that will experience adverse effects from suspended sediment or changes in salinity caused by the proposed action with any meaningful level of accuracy. We cannot predict the number or duration of salinity changes, nor the number of individual fish that will be exposed to each pulse. Furthermore, not all exposed individuals will experience direct adverse effects. However, we expect that some individuals of listed fish species will experience sublethal effects such as stress and reduced prey consumption, some may respond with avoidance behaviors, and some may be injured. Those that engage in avoidance behaviors or with raised cortisol levels may have decreased predator detection and avoidance (Olla et al.1992). These effects will reduce the condition of PS Chinook salmon.

Fish Response to Effects on the Food Web and Loss of Foraging Opportunities

The disconnectedness of floodplains caused by tidegates also affects the aquatic food web (Winemiller 2004). The inundation of vegetated floodplains provides macrodetritus—a base-level food source. A reduction or elimination of floodplain inundation results in a corresponding reduction in macrodetrital inputs. This reduction in floodplain inundation and macrodetrital inputs has been associated with reductions in flow, the loss of floodplains (e.g. fill, revetments and levees), and habitat simplification (NMFS 2011). Junk et al. (1989) found that most vertebrates found in a mainstem channel greatly depend directly or indirectly on primary production in adjacent floodplains, when a regularly inundated floodplain is present. Developments have separated large temperate mainstem rivers from their floodplains (Junk et al. 1989). Therefore, the reduction in floodplain connectivity associated with the proposed action, through this pathway, may further reduce stream productivity and forage availability for rearing PS Chinook salmon and steelhead.

Fish Response to Impaired Access and Loss of Estuary Habitat

This section discusses the importance of estuary habitat to Chinook salmon with a focus on the Skagit populations that will be impacted by the proposed action. As discussed above, even if juvenile fish have some ability to access the estuarine areas behind the tidegate, the proposed action will limit access to this important rearing habitat. In addition to impairing access, the proposed action will reduce the quantity of available estuarine habitat, causing, among other things, density-dependent effects as discussed below.

All six wild Skagit Chinook salmon stocks include delta rearing and fry migrant life history types in their populations. These life history types currently rear in Skagit delta and pocket estuary habitats if available to them. Skagit delta and pocket estuary habitats are currently much smaller and more isolated than historically available habitats (Simenstad et al. 2011). Therefore, rearing opportunities of delta-rearing Chinook salmon juveniles and fry has been greatly reduced. At contemporary Chinook salmon population levels, current delta habitat conditions are limiting the number and size of juvenile Chinook salmon rearing in delta habitat, which include blind channels, distributary channels, pocket estuaries, and off-channel backwater areas. Limitations in available delta habitat conditions are displacing juvenile Chinook salmon from delta habitat into Skagit Bay habitat and forcing a change in their life history strategy from delta-rearing to estuary-rearing (Beamer et al. 2005). Fry migrant survival in the deeper waters of the estuary is much lower than delta-rearing individuals (Quinn 2005).

As juvenile Chinook salmon move out of the estuary, they face a changing gradient of environmental conditions, such as increasing salinity, depth, different food sources, and types of predators. These changing conditions are particularly challenging for fry migrants, and result in large rates of mortality, such that the vast majority do not return as adults (Quinn 2005). Those Chinook salmon that do return as adults have successfully avoided many predators, such as other fish, birds, and marine mammals. Among the many factors that contribute to the return rates of adult Chinook, the timing of juvenile entry to the sea, smoltification status, and their size influence the probability of fish to survive and grow.

The density of juvenile PS Chinook salmon within blind channels and sloughs, growth of fish, and emigration of fry is dependent upon the amount of juveniles moving downstream from freshwater habitat. The wealth of information regarding Skagit Chinook salmon emigration and use within the estuarine portions of the Skagit point to several synergistic population level ramifications of reduced and blocked estuary habitat. Beamer et al. (2005) reasoned that if tidal delta habitat used by juvenile Chinook salmon has been reduced by 88%, then there should be a limitation on the number or size of juvenile Chinook salmon rearing in tidal delta habitat over varying freshwater smolt outmigration population sizes. If tidal delta habitat were limiting, then the juvenile Chinook salmon population would experience lower survival in tidal delta habitats or displacement from tidal delta habitats. Displacement would likely result in proportionally more juvenile Chinook salmon in Skagit Bay earlier in the year (coinciding with the tidal delta rearing period). They found that the relationship between freshwater wild juvenile Chinook salmon population size and wild juvenile Chinook salmon abundance in tidal delta habitat is density dependent and that as the total freshwater smolt population increased, average residence time in tidal habitat declined.

Though the exact mechanisms that trigger density-dependent emigration are unknown, it appears that social behavior may play a significant part during periods of high habitat density. PS Chinook fry that arrive within stream and estuarine habitats that already host larger, older Chinook must either compete with these fish for food, or emigrate in search of other habitat. In these instances, interaction occurs that dislodges smaller, less developed Chinook salmon (Reimers 1968; Beamer et al. 2005). If the entire suite of estuarine habitat is occupied, fry must move to higher saline waters. In one experiment, all juvenile Chinook that volitionally emigrated troughs placed in streams were 43 mm or smaller, with the dominant Chinook that remained 67 mm (Reimers 1968). Within the Sixes River estuary, juvenile Chinook displayed antagonistic behavior (such as nipping, lateral display, fighting, chasing, fleeing, submission, and redirected aggression) during the ebb tides, and as the tide flooded, fish dispersed to shallower habitat, and antagonistic behavior ceased (Reimers 1968). Reimers (1968) hypothesized that without this dispersal mechanism, juvenile Chinook would be subject to possible shortages of food, and Skagit estuarine data support this hypothesis (Simenstad et al. 1982; Thorpe 1994; Beamer et al. 2005). Density-dependent emigration has been documented outside of the Skagit Watershed as well. Similar to the Skagit, juvenile Chinook salmon emigration from the Sixes River (Oregon) estuary was observed during periods of high juvenile Chinook abundance in the estuary (Reimers 1973): "During the time of large population abundance…many juveniles left the (Sixes River) estuary and were captured in the ocean surf." Another mechanism that likely leads to some fry movement into saltwater may occur during large outgoing tides and/or high river discharges, which force fish to pass through the mainstem estuary with little opportunity to reside in lower velocity channels, in part because so many of these channels are isolated behind dikes and tidegates.

Beamer et al. (2005) also found that the proportion of the total wild juvenile Chinook salmon population that bypasses rearing in tidal delta habitats and migrates directly to Skagit Bay (fry migrants) increases with wild smolt outmigration levels. Therefore, at least some of the density dependence occurring in the tidal delta results in the displacement of juvenile Chinook salmon out of the rearing habitats in the tidal delta where they end up in the deeper and more saline Skagit Bay. Similarly, Greene and Beechie (2004) determined that the best opportunity for restoring capacity to the Skagit Chinook population would be to increase tidal delta habitat. These results demonstrate density-dependent growth within the estuary and density-dependent emigration into Skagit Bay and support the idea that present day Skagit tidal delta habitat conditions are limiting the capacity of tidal delta-rearing Chinook salmon. The proposed action will continue to impede access to areas of potential estuarine habitat for at least 50 years. The TFI calculated the area influenced by the No Name Slough tidegates being replaced by the proposed action at 207 acres. This best available analysis supports our conclusion that loss of estuary habitat quality and quantity caused by the tidegate reduces population abundance and productivity by reducing survival.

The longer wild sub-yearling Chinook spend in the delta, the greater their growth rate in the bay. Studies in yearling spring Chinook salmon have demonstrated that faster growth prior to seawater entry in the spring improves smolt physiology (seawater adaptability) and smolt-to-adult survival (Wagner et al. 1969; Beckman et al. 1999). Individuals that spend the longest time in the delta are best able to take advantage of conditions in the bay for accelerated growth while fry migrants that spend no time in the delta grow poorly in the Bay. Beamer and Larson (2004) concluded that this reflects their low bay growth rate, their size at entrance to the bay, and the early time of year they appear in the bay—all factors pointing to poor growth and a high risk of predation compared to other life history types. Increased time of residence in the delta equates to a larger size before entering bay habitat. Larger sub yearling Chinook have lower predation rates (Parker 1971), survived to adulthood at much higher rates (Bilton 1984), and have greater seawater tolerances than smaller fish (Clark and Shelbourne, 1985). Faster growing and larger juvenile Chinook have a survival advantage over smaller individuals. The diminished quantity and quality of nearshore habitat in the Skagit delta forces some juvenile Chinook salmon to prematurely enter the bay where they are not well suited to survive (Beamer and Larson 2004).

Fry migrants are less fit to survive within seawater for several reasons. In addition to (or because of) their small size and slow growth rate, they may have not initiated or finished smoltification, which places them at physical, physiological, and possibly behavioral disadvantages in saltwater. Smoltification and growth are interrelated; Chinook that are rapidly growing possess an osmotic and ionic regulatory system that is more functional at higher saline waters, and may be capable of being initiated more quickly in response to changing saline gradients (Wagner et al. 1969). In an experiment that investigated the importance of transitions from fresh to saltwater, juvenile Chinook salmon that were taken from freshwater and placed in saltwater had much higher mortality rates than those fish that were gradually moved to riverine or estuarine sites (Macdonald and Levings 1988). The streamlining of the body during smoltification enables juvenile Chinook to swim faster, which is their primary mechanism to avoid predators (Quinn 2005). Without coloring changes that adapt them to the saltwater environment, fry may be seen more readily by predators compared to Chinook salmon that have finished smoltification. If the important ion-processing kidney and gill changes are not complete, fry may be under physiological ‘distress’ that compromises immune function, predation avoidance, and pursuit of food. Without the complete development of defined teeth, combined with their small size, fry are not able to take advantage of the diversity of food sources (such as juvenile fish) in seawater. Finally, fry may not have adapted behaviorally (i.e. surface orientation that makes them vulnerable to birds) to life in saltwater.

Salmonid mortality within ocean environments occurs from predation, disease, parasites, and starvation, some of which may act synergistically and result in death. An inverse relationship between salmonid migrant size and ocean mortality has been identified (Ricker 1962 and 1976; Ward and Slaney 1988; Martin and Wertheimer 1989; Holtby et al. 1990). McGurk (1995) reported body weight as the most important variable affecting relative smolt to adult survival rates analyzed. Among these mortality agents, most is known about predation; smaller salmonids are preferred prey targets (Parker 1971; Henderson and Cass 1991; Ward et al. 1989). Though the precise cause of apparent early marine mortality has not been readily identified for most juveniles as they leave freshwater and the estuary, predation risk does decrease as juveniles grow (Ricker 1976).

Fry migrant juvenile Chinook are smaller when they enter Skagit Bay, and grow slower relative to those that can use the estuary, thus their vulnerability to predation occurs for a longer period of time. Evidence of predation (and other injury or death factors) exists for fry migrants; after approximately 20 days, fry migrants are no longer found in Skagit Bay, while all other rearing types are detected from 20 to 100 days after entrance into saltwater (Beamer and Larsen 2004). Similar to the Sixes River, the fry migrant life history has yet to be documented within adult returns in the Skagit (Beamer et al. 2005).

In addition to Skagit Basin-specific data on juvenile Chinook size and abundance, several independent data sets and studies support the conclusion that smaller juvenile Chinook migrants do not survive in the ocean. An experimental release of Chinook fry into riverine, estuarine, marine and transition (nearshore between marine and estuarine zones) habitat within and near the Campbell River (Canada), was conducted, and analyzed subsequent adult return rates in the following years. In five years of adult returns, fish that were released into the estuary returned at 3.3 times the rate as fish released into marine habitats (which are analogous to fry that emigrate directly to Skagit Bay) (Levings et al. 1989). In a multi-year comprehensive study of Chinook in the Sixes River, Reimers (1973) reported that Chinook that resided in the estuary the longest represented 90.6 percent of the returning spawners, with the rest of the returning adults reared for up to one year within freshwater as juveniles. The loss of estuarine habitat, the reduction of its quality, and the loss of access by juvenile salmonids reduces their condition, growth, and survival.

SRKW Response to Enduring Effects of Tidegate Replacement

The proposed action reduces the quality and quantity of estuarine habitat behind the proposed tidegate and nearshore habitat in front of the tidegate, which, as described above, in turn reduces the abundance of PS Chinook salmon, an important prey item for SRKW. The enduring effects of the tidegate replacement on SRKW, caused by a reduction in PS Chinook salmon abundance for 50 years, are similar in kind to the enduring effects discussed above caused by the impacts to the nearshore habitat. We refer back to that section for a full explanation. Implications to SRKW population viability are discussed below.

Effects on of the Proposed Action on Population Viability

We assess the importance of effects from the proposed No Name Slough project in the action area to the ESUs/ DPS by examining the relevance of those effects to the characteristics of Viable Salmon Populations (VSPs). The characteristics of VSPs are sufficient abundance, population growth rate (productivity), spatial structure, and diversity (McElhany et al. 2000). While these characteristics are described as unique components of population dynamics, each characteristic exerts significant influence on the others. For example, declining abundance can reduce spatial structure of a population when habitats are less varied diversity among the population declines. Due to the short duration and limited geographic scale, none of the temporary effects are likely to have any meaningful impact on the affected populations of PS

Chinook salmon or steelhead. We expect the enduring effects from the proposed action will have a persistent, chronic, negative impact on the survival of juvenile PS Chinook salmon. The adaptive ability of these threatened 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). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future. The impacts expected from climate change are addressed in Section 2.2 (Rangewide Status of the Species and Critical Habitat).

PS Chinook Salmon

The proposed action would:

1. Reduce the abundance and productivity of affected populations of PS Chinook salmon by increasing mortality at the juvenile life stage. This would occur through loss of nearshore habitat quality caused by the tidegate and shoreline armoring.
2. Reduce the abundance and productivity of affected populations of PS Chinook salmon by increasing mortality at the juvenile life stage. This results from the interruption of fish passage caused by the operation of the tidegate and maintaining what would be saltwater marsh/estuary habitat as agricultural land with low habitat value for salmonids. Absent the tidegate, this estuary habitat would provide high quality rearing habitat for PS Chinook salmon.
3. Reduce the spatial structure of the affected populations by maintaining what would be saltwater marsh/estuary habitat as agricultural land with low habitat value.

Skagit Populations Related to the Evolutionary Significant Unit

The six Skagit populations are critical to PS Chinook salmon ESU-wide abundance and productivity. Through straying of adult Chinook, the Skagit populations may provide an important source of fish to colonize under-utilized habitat, or habitat where local populations have been extirpated within the rest of the ESU. Nearly 50 percent of the naturally produced fish within the ESU are within the Skagit River, and such a large component of the ESU likely has a proportionally large role of straying adults. The Skagit watershed is located between the Nooksack and Stillaguamish Rivers, which each have two Chinook populations that are at very poor abundance levels, and adult Chinook straying to these two systems may occur on a regular basis because of their proximity to the Skagit. Evidence of straying and population intermingling with the North Fork Stillaguamish Chinook population comes from their close genetic similarity (Marshall et al. 1995). If the Skagit populations continue to decline or stay at static abundance levels, and a concurrent loss of straying fish occurs, this loss may undermine contributions to successful colonization of the rest of the ESU.

The population-level effects would cause an appreciable reduction of the Puget Sound ESU to survive and recover because, individually and collectively, the six Skagit stocks are critical to ESU-wide life-history and genetic diversity. In all, 27 percent of the ESU’s populations reside in the Skagit system. Three of the remaining seven Spring PS Chinook populations in the ESU, reside in the Skagit. These three spring Chinook stocks are particularly important to the ESU because of the widespread loss of spring Chinook distribution and abundance in the ESU, and because they offer a greater degree of life-history diversity relative to summer/fall populations. The six Skagit populations encompass most of one of six designated genetic diversity units that provide the genetic reserves and life history 'building blocks' to increase the probability of species survival and facilitate recovery. All of the Skagit population's genetic 'baselines' have been relatively uninfluenced by historic and present-day hatchery releases (NWFSC 2015; Ford 2022).

The population-level effects would cause an appreciable reduction of the Puget Sound ESU to survive and recover because, individually and collectively, the six Skagit stocks and the Skagit watershed are critical to ESU-wide spatial structure. The Skagit River is the largest and most hydrologically diverse watershed in the ESU, and portions of the upper watershed feature relatively good habitat. The Skagit Chinook spawning habitat is the most geographically removed from the rest of the ESU's spawning habitat, which provides enhanced ESU protection from environmental disturbances, and facilitates increased life-history and genetic diversity. Its large size and habitat variety also enables larger populations to reside within the basin, which in turn can lead to enhanced life-history and genetic diversity. Despite the relative healthy abundance and diversity of the Skagit Basin Chinook populations in the ESU, they are at less than 20 percent of their overall recovery goal, and have experienced 15-year declining trends in abundance (Figure 9) (Ford 2022).

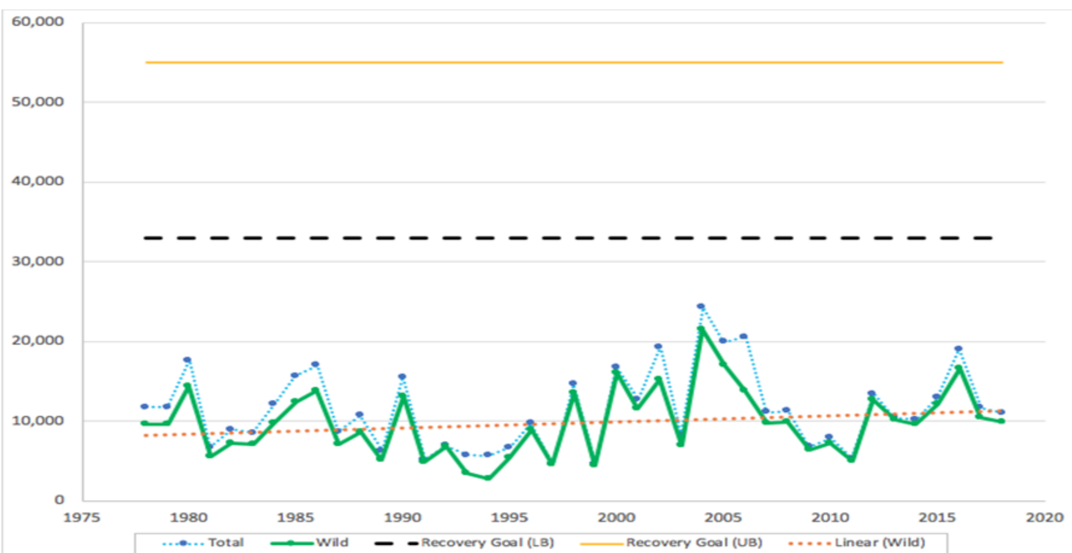

Figure 9 Abundance trend of wild and total PS Chinook salmon populations from the Skagit River vs. two different recovery goals. Figure reproduced from Ford 2022. The lower recovery goal reflects an abundance target if adult salmon merely replace themselves in the production of offspring (i.e. one adult offspring returns to spawn for every parent). The upper recovery goal reflects the abundance target needed for recovery if productivity reflected recent levels of offspring replacing their adult parents.

Puget Sound Steelhead

Juvenile PS steelhead primarily emigrate from natal streams in April and May, and appear to move directly out into the ocean to rear, spending little time in the nearshore zone (Goetz et al. 2015), despite some observations of steelhead smolts found in low abundances in the marine nearshore (Brennan et al. 2004) PS steelhead are not known to spawn in No Name Creek and No Name Slough is unlikely to be an important rearing area for this species. Further, as explained above, nearshore habitat is less important to steelhead than it is to PS Chinook salmon. For these reasons, the proposed action would not cause any population-level effects on PS steelhead.

SRKW

The long-term reduction of PS Chinook salmon abundance caused by the proposed action is likely to lead to nutritional stress on SRKWs. Nutritional stress can lead to reduced body size and condition of individuals and can also lower reproductive and survival rates. Prey sharing would distribute more evenly the effects of prey limitation across individuals of the population that would otherwise be the case. Therefore, poor nutrition from the reduction of prey could contribute to additional mortality in this population. Food scarcity could also cause whales to draw on fat stores, mobilizing contaminants stored in their fat and affecting reproduction and immune function.

We review the population level effects on SRKW using the same parameters for viability, namely abundance, productivity, spatial structure, and distribution. This distinct population segment comprises three groups, J, K, and L pods. Abundance is low, (J pod = 25, K pod = 16, L pod = 34) as of April, 2024. Productivity is likely to be impaired by the relatively high number of males to females. Spatial distribution has high inter-annual variability, and diversity is at risk because of the low abundance.

These threats were reviewed by Murray et al. (2021), who found a “cumulative effects” model was better at determining population impacts compared to individual threats. The “cumulative effects” model indicated that Chinook salmon abundance was the most sensitive model parameter, however they highlighted the importance of considering threats collectively. Lacy et al. (2017) developed a PVA model that attempts to quantify and compare the three primary threats affecting the whales (e.g. prey availability, vessel noise and disturbance, and high levels of contaminants). The Lacy et al. (2017) model also found that Chinook salmon abundance was the most important threat to SRKW population growth; however, they also emphasized that prey increases alone would likely not be sufficient to recover the whales and that the other threats would need to be addressed as well. *See also* Williams et al. (2024) (concluding the threat with the greatest impact to SRKW population growth is the availability of Chinook salmon) and Nelson et al. (2024) (using an integrated population modeling framework to evaluate the relative importance of multiple threats, including Chinook salmon abundance, to SRKWs, finding modest evidence that Chinook salmon abundance is positively associated with survival rates, and suggesting, in combination with other research, that the recovery of SRKWs may be limited by prey availability).

The most recent effort to review the relationships of SRKW vital rates and Chinook salmon abundance was conducted by an Ad Hoc Workgroup through the PFMC (PFMC 2020).

However, the Workgroup did not assess the cumulative threats, and found that the small population size limited their ability to detect a quantitative relationship between Chinook salmon abundance and SRKW demographic metrics (e.g. fecundity and survival) to input into their PVA and the relationship is likely not linear or not constant over time (PFMC 2020). Although there are challenges to detecting quantitative relationships and others have cautioned against overreliance on correlative studies (see Hilborn et al. 2012), given the status of the species (endangered with low abundance and productivity), and their strong preference for Chinook salmon prey, the continued existence and potential for recovery of the species is highly dependent on healthy numbers of Chinook salmon throughout its range.

The enduring effects of the proposed action include the suppression of productivity among (i.e., reduced survival of juvenile) PS Chinook salmon populations during the 50-year time period, and spatial and temporal depletions in Chinook salmon presence. This in turn limits the number of adult PS Chinook salmon available as prey for SRKW over the long-term, as well as causing SRKW to expend energy to seek prey in other locations due to spatial and temporal depletions. These effects of the proposed action are likely to be experienced by all members of this species.

As mentioned previously, there are several factors identified in the final recovery plan for SRKWs that may be limiting recovery: quantity and quality of prey, toxic chemicals that accumulate in top predators, and disturbance from sound and vessels. It is likely that multiple threats are acting together, and while it is not clear which threat or threats are most significant to the survival and recovery of SRKW, all of the threats are important to address. Effects of the proposed action on SRKW would be due to the project's adverse effects on Chinook salmon, the whales preferred prey. Given the status of the species (endangered with low abundance and productivity), and their strong preference for Chinook salmon prey, the continued existence and potential for recovery of the species is highly dependent on healthy numbers of Chinook salmon throughout its range.

The reduction in the number of adult PS Chinook salmon available as prey for SRKW over the long-term would likely result in additional stress and a lower likelihood of survival and reproduction for individual whales in response to decreased prey availability. The Southern Residents would likely increase foraging effort or abandon areas in search of more abundant prey. Reductions in prey or a resulting requirement of increased foraging efficiency would increase the likelihood of physiological effects. The Southern Residents would likely experience nutritional, reproductive, or other health effects (e.g., reduced immune function from drawing on fat stores and mobilizing contaminants in the blubber) from this reduced prey availability. These effects would lead to reduced body size and condition of individuals and can also lower reproductive and survival rates. In particular, the reduction in available prey is likely to put further stress on SRKW juveniles, pregnant females, and nursing females, with likely mortality (decrease in abundance) and decreased fecundity (decreased productivity).

Because of this population's small size, it is susceptible to rapid decline due to demographic stochasticity, and genetic deterioration. Small populations are inherently at risk because of the unequal reproductive success of individuals within the population. The more individuals added to a population in any generation, the more chances of adding a reproductively successful individual. Random chance can also affect the sex ratio and genetic diversity of a small population, leading to lowered reproductive success of the population as a whole. For these reasons, the failure to add even a few individuals to a small population in the near term can have long-term consequences for that population's ability to survive and recover into the future. A delisting criterion for the SRKW DPS is an average growth rate of 2.3 percent for 28 years (NMFS 2008). In light of the current average annual growth rate of 0.1 percent, this recovery criterion and the risk of stochastic events and genetic issues described above underscore the importance for the population to grow quickly.

Particularly in light of the small population size and the associated risks, the enduring effects of the proposed action could limit survival and impede the recovery of the PS Chinook salmon ESU by reducing the potential for population growth and increasing the likelihood of additional loss of individual whales. Further reductions in Southern Resident prey quantity, or spatial or temporal depletions would reduce the representation of diversity in SRKW life histories, resiliency in withstanding stochastic events, and redundancy to ensure there is a margin of safety for the salmon and Southern Residents to withstand catastrophic events. Long-term prey reductions affect the fitness of individual whales and their ability to both survive and reproduce. Reduced fitness of individuals increases the mortality and extinction risk of Southern Residents and reduces the likelihood of recovery of the DPS.

2.5.2 Effects on Critical Habitat

Critical habitat for PS Chinook salmon and SRKW occur within the nearshore and marine portion of the action area. PS steelhead do not have nearshore or marine habitat areas designated as critical. Critical habitat is not designated for any listed species landward of the tidegate and shoreline armoring. NMFS reviews effects on critical habitat affected by a proposed action by examining how the PBFs of critical habitat will be altered, and the duration of such changes, and the influence of these changes on the potential for the habitat to serve the conservation values for which it was designated. The proposed action would extend the life of 85 linear feet of shoreline armoring in Puget Sound for 50 years (total shoreline armoring is proposed to include 62 linear feet of large rock and 23 linear feet of vertical concrete structural support for the tidegates). The effects that this structure exerts on habitat features and functions also would persist for the same duration, into the future.

Puget Sound Chinook Salmon Critical Habitat

The effects of the proposed action on PS Chinook salmon and its habitat are described thoroughly above; below is a summary of those effects in relation to the PBFs of critical habitat for this species. As outlined above, in addition to our qualitative analyses of habitat impacts, our quantitative analysis using the Puget Sound Nearshore Calculator provided an output of -275 debits (-2.75 DSAYs) for the impact of the dike to nearshore habitat. *See also* Appendix 1, 2, and 5. Neither our qualitative PBF analysis or quantitative analysis include impacts on habitat behind the tidegate.

PBF 4—Estuarine areas (this does not include the area behind the tidegate, which is not designated as critical habitat. As explained earlier, the area directly in front of the tidegate has characteristics of nearshore and estuary habitat. This analysis pertains only to the area in front of the tidegate):

a. Forage – Short-term reduction in forage due to turbidity during construction. Loss of forage quality and quantity due to impaired water quality from daily openings of the tidegate post-construction.
b. Free passage – Temporary disruption of free passage due to underwater noise from sheet pile driving and construction.
c. Natural cover – Loss of natural cover resulting from suppression of submerged aquatic vegetation due to daily impaired water quality releases from the tidegate.
d. Salinity – intermittent discharges of lower salinity water from behind the tidegate.
e. Water quality – Temporary water quality degradation in the estuary, including increased temperature and turbidity, due to construction activities and daily releases of impaired water quality from the tidegates. Reduced dissolved oxygen and resuspension of contaminated sediments from construction activities and daily releases of water from the tidegates.
f. Water quantity – no effect.

PBF 5—Nearshore marine areas:

a. Forage – Short-term reduction in forage due to turbidity during construction. Enduring loss of forage production due to shoreline armoring and isolation from riparian prey sources. Loss of forage quality and quantity due to introduction of water quality and contaminants from daily openings of the tidegates post-construction.
b. Free passage – Temporary disruption of free passage due to underwater noise from sheet pile driving and construction.
c. Natural cover – Reduction in SAV which decreases cover for rearing juvenile PS Chinook salmon
d. Water quantity – no effect
e. Water quality – Temporary water quality degradation, including reduced dissolved oxygen, resuspension of contaminated sediments, and turbidity, due to construction activities, and enduring water quality degradation, including increased turbidity, increased temperature, reduced dissolved oxygen, and salinity changes from the presence of and daily openings of the tidegate, post-construction.

Water Quality

Designated critical habitat will experience temporary and enduring declines in water quality (a PBF of Chinook critical habitat). Temporary and enduring declines in water quality would result from the proposed action. Water quality would be temporarily degraded during construction work associated with the removal of piles, removal and replacement of tidegate structures, removal and replacement of sheet piles, and removal and replacement of shoreline armoring including large rocks. The enduring effects will be caused by the presence of, and daily operation of, the tidegate for its extended life of 50 years.

Turbidity - The proposed action will cause temporary decreases in water quality. Such activities include project construction tasks. Excavation and sheet pile installation will increase turbidity, decreasing existing water quality in the action area. Increased turbidity would also persist in bursts following construction as degraded water conditions are released daily from No Name Sough during ebbing tides for its extended life of 50 years.

To address increased turbidity during construction, the applicant proposes to isolate the worksite from Padilla Bay using sheet piles, some of which would remain after construction. The construction site is proposed to be isolated from No Name Slough by installing sheet piles and routing the brackish water to Padilla Bay using pumps. In estuaries, state water quality regulations establish a mixing zone of 300 feet plus the depth of water over the discharge port as measured during mean lower low water. Elevated turbidity is expected to persist about 1,700 meters into Padilla Bay at low tide where it would likely mix and return to baseline conditions shortly after in-water work and post-construction water releases are complete. Outside of in-water work and post-construction water releases, elevated turbidity is likely to occur when tidal water and No Name Slough flows re-inundate excavated areas, and during daily releases of water from behind the No Name Slough tidegate during ebbing tides, which are expected to occur for its extended life of 50 years.

Temperature - By blocking the normal bidirectional movement of water, tidegates disrupt the gradual change in water temperature that occurs between the marine waters and the brackish waters behind them. Consequently, tidegates create sharp transitions in water temperature (Bates 1999; Portnoy 1999; Portnoy and Giblin 1997; Portnoy et al. 1987). For example, tidegates are known to have caused a 2°C - 5°C difference in water temperature above and below the tidegate (Bates et al. 1999; Giannico and Souder 2005; Beamer et al. 2014). Thus, the presence of the tidegate will cause increased water temperatures behind the gate, and increased temperatures in front of the gate when that water is released daily with ebbing tides. For juvenile Chinook salmon rearing on the marine side of the tidegate, rapid changes in temperature of 1°C - 4°C can elicit increased levels of stress in juvenile Chinook salmon and alter their swimming behavior (Quigley and Hinch 2006) as well as increase the risk of disease and parasites and mortality (Bjornn and Reiser 1991).

Dissolved Oxygen - Elevated temperatures and water turbidity can reduce dissolved oxygen (DO) within the mixing zone of the marine side of the tidegate during construction and during periodic releases from No Name Slough. No Name Slough is listed for low dissolved oxygen with recorded violations during high flow conditions. Thus, during periodic tidegate openings, reduced DO is expected to exceed the established mixing zone of 300 feet plus the depth of water over the discharge port(s) as measured during mean lower low water. During low tide, it is unlikely that DO would be significantly impacted by the proposed action because low oxygen levels in the outflow during construction would likely re-oxygenate in the marine channel of No Name Slough channel prior to mixing with the marine waters of Padilla Bay. However, at high tide, it is likely that low DO would exceed the established mixing zone of 300 feet plus the depth of water over the discharge port(s), especially during summer months when temperatures are relatively elevated. Construction activities (excavation and sheet pile installation/removal) will increase turbidity and decrease DO in the action area, especially as material is removed from the project site. We expect that reduced levels of DO from construction-related activities will return to near normal levels within hours after construction stops. However, we expect reduced levels of DO to persist with daily releases of flow from No Name Slough during ebbing tides.

Contaminants - Re-suspension of contaminants is likely to occur during the proposed pile removal. PAH chemicals are known to create toxic conditions for organisms associated with creosote piles (West et al. 2017, Yanagida et al. 2012). Creosote-treated piles can contaminate surrounding sediment up to two meters away with PAHs (Evans et al. 2009) and removing creosote-treated piles would mobilize PAHs that have settled into surrounding sediments (Smith 2008; Parametrix 2011). Projects can also release PAHs directly from creosote-treated piles during the demolition if piles break during removal (Parametrix 2011). However, studies have shown that the concentration of creosote derived PAHs released into surface water rapidly dilutes. Smith 2008 reported concentrations of total PAHs of 101.8 μg/l 30 seconds after creosote-pile removal and 22.7 μg/l 60 seconds after. However, PAH levels in the sediment after pile removal can remain high for six months or more (Smith 2008). Romberg (2005) found a major reduction in sediment PAH levels three years after pile removal. Thus, whereas the removal of creosote timber piles is likely to increase PAH chemicals in the short term, they are likely to reduce leaching of chemical compounds into nearshore and marine sediments over the long term, providing a net benefit to critical habitat in a relatively short amount of time.

As with suspended sediments, re-suspended contaminants resulting from the proposed work are expected to be detectable above background levels near the project area, but diminish in the established mixing zone of 300 feet plus the depth of water over the discharge port(s) as measured during MLLW. Adverse water quality effects will likely abate as the contaminated materials settle out, at which point they would persist in the substrate. Accumulation of contaminants in benthic sediments can cause chronic or sublethal effects to prey and forage species and is discussed later. Re-suspension of contaminants is unlikely to reduce the quality of critical habitat over the long term.

Noise

Increased noise and sound pressure during construction reduce water quality and habitat utility. Noise and other sound inputs will increase during vibratory pile driving. Sound pressure waves transmitted through the water diminish the quality of the free passage PBF within the affected zone.

Increased noise would likely occur for short periods of time during specific activities including sheet pile driving and during in-water work to build, repair, and replace structures and from dredging activities. Excavators will be used to construct the proposed project. In each case, the operation of the excavators will increase the amount of noise in the area surrounding each construction site. Both vibratory noise and impact noise can create sufficient disturbance to degrade critical habitat PBFs.

To minimize the effects of increased noise, in-water construction at the toe of the levee and tidegate would occur during low tide. Working at low tide will limit the intensity of sound propagation into the water.

Effects on Forage and Prey

As explained previously in this Opinion discussing habitat and effects on species and below, designated critical habitat for PS Chinook salmon will experience temporary and enduring declines in forage or prey communities from the proposed action.

Physical processes - The impacts of hard armor along shorelines are well documented (Johannessen et al. 2014). Armoring of the nearshore can reduce or eliminate shallow water habitats through the disruption of sediment sources and sediment transport.

Shoreline armoring degrades sediment conditions, forage base, and access to shallow water waterward of the structures. Armoring also prevents access to forage and shallow water habitat upland of the structures during high tides. Shoreline armoring replacement would increase the rate of beach erosion from higher wave energy compared to a natural shoreline and scour released from the tidegate after high tides. This leads to beach lowering, increases in sediment temperature, and decreased SAV establishment and persistence, leading to reductions in primary productivity and invertebrate density within the intertidal and nearshore environment (Bilkovic and Roggero 2008; Fresh et al. 2011; Morley et al. 2012; Dethier et al. 2016).

Shoreline armoring structures in the intertidal zone changes the hydrodynamics of the waves washing up on the beach. Hard structures reflect waves without dissipating their energy the way a natural beach would, especially if vegetation is present (Griggs, 2010; Ruggiero, 2010). In addition to higher rates of beach erosion by increased wave energy, the proposed shoreline armoring would also limit the delivery of sediment from tidegate-associated ditches to the beach, further diminishing the supply of fine sediment to beaches and facilitating the necessity of ditch dredging by project applicants. Shoreline armoring generally reduces the sediment available for transport by disconnecting the sediment source, potentially causing loss of beach width and height as transport of material outpaces supply (Shipman 2010).

Shoreline armoring alters physical functional processes, causing a shift in the biological communities affected by those processes. The effects of shoreline armoring cascade through the Puget Sound food web. The consequences can be seen in the population declines of a variety of species that depend on these ecosystems, from shellfish, herring, and salmon to orcas, great blue heron, and eelgrass. The number and types of invertebrates, including shellfish, can change; forage fish lose spawning areas; and juvenile salmon and forage fish lose the feeding grounds that they use as they migrate along the shore (Shipman et al. 2010). Native shellfish and eelgrass have specific substrate requirements and altered geomorphic processes can leave shellfish beds and eelgrass meadows with material that is too coarse or with too much clay exposed. Finer materials like gravel and sand provide important spawning substrate for sand lance (*Ammodytes hexapterus*) and surf smelt (*Hypomesus pretiosus*). Therefore, a reduction of gravel and sand within the intertidal and nearshore zone as a result of the proposed shoreline armoring would reduce potential spawning habitat availability and fecundity of both species (Rice 2006; Parks et al. 2013); both species are important prey of PS Chinook salmon.

Deepening of the intertidal zone adjacent to the shoreline armoring and increased wave energy, are also reasonably certain to reduce SAV (Patrick et al. 2014). Salmonids are affected by the loss of prey communities, some of which depend on SAV for various of their own life histories, including spawning. When shoreline armoring and management removes vegetation, the loss of shading and organic material inputs can increase forage fish egg mortality (Penttila 2007). Surf smelt, for example, use about 10 percent of Puget Sound shorelines for spawning and many shoreline armoring projects are built in forage fish spawning habitat, threatening their reproductive capacity (Penttila 2007).

A reduction in eelgrass could cause a reduction in potential spawning habitat for Pacific herring, another forage species for salmonids. Shoreline armoring can also physically bury forage fish spawning beaches when structures are placed in or too close to the intertidal zone. Besides being prey, a sometimes-overlooked benefit of forage fish abundance to salmonids is their use as a prey buffer against marine mammal and bird predation. Moore et al. (2021) found that the high abundance of age-1+ anchovy in the Puget Sound provided an alternative prey source for predators of out-migrating steelhead smolts which resulted in an increase in smolt survival.

Shoreline armoring located within the intertidal zone (below HAT) limits the upper intertidal zone and natural upper intertidal shoreline processes such as accumulation and ecological use of beach wrack (Sobocinski et al. 2010; Dethier et al 2016). There is a reduction in forage by juvenile salmonids as a result of lost access to beach wrack and associated habitat as primary productivity and invertebrate abundance in both the intertidal and nearshore environments is diminished. Invertebrates are an important food source for juvenile PS Chinook salmon and for forage fish, prey species of salmonids.

Designated critical habitat will have enduring diminishment of aquatic vegetation, beach wrack, and benthic communities in the migration areas of juvenile PS Chinook salmonids. We anticipate impacts to epibenthic forage will be diminished, or fail to establish due to the shoreline armoring. Shoreline armoring will reduce the quality of this PBF. Aquatic vegetation and beach wrack are important in providing cover and a food base for juvenile PS Chinook salmon. Loss of aquatic vegetation (Kelty and Bliven 2003) which creates a reduction to the shoreline primary production, is likely to incrementally reduce the food sources for juvenile PS Chinook salmon. The reduction in food sources includes epibenthos (Haas et al. 2002) as well as forage fish.

Southern Resident Killer Whale Critical Habitat

The PBFs of SRKW critical habitat are:

1. Water quality to support growth and development—minor water quality diminishment during construction activities;
2. Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth—discussed below; and
3. Passage conditions to allow for migration, resting, and foraging—no effect.

The only SRKW PBF we expect to be meaningfully affected by the proposed action is prey.

Prey

Enduring declines of SRKW's prey as a result of the proposed action is expected to occur. The proposed shoreline armoring and tidegate structures are expected to reduce nearshore habitat quality, decrease rearing opportunities and increase predation on juvenile salmonids. Likewise, the proposed shoreline armoring is expected to interrupt natural shoreline processes, degrading nearshore habitat. Over time, this is expected to reduce the amount of salmon available as forage for SRKWs. The existence and operation of the proposed tidegate and associated shoreline modifications are also expected to impair and inhibit the availability and quality of estuary habitat, reducing its value for rearing PS Chinook salmon. The continued decline and reduced potential for recovery of the PS Chinook salmon as a PBF of SRKW critical habitat is likely to alter the abundance and distribution of migrating salmon and increase the likelihood of localized depletions in prey, with adverse effects on the SRKWs' ability to meet their energy needs. SRKWs could abandon depleted areas in search of more abundant prey, and end up expending substantial effort only to find depleted prey resources elsewhere. Increasing the risk of a permanent reduction in the quantity and availability of prey, and the likelihood for local depletions in prey populations in multiple locations over time, reduces the conservation value of critical habitat for SRKWs.

Critical Habitat Summary

The chronic and enduring diminishments of critical habitat created by the proposed shoreline armoring and tidegate structure to water quality, cover, and forage prey will incrementally degrade the function of critical habitat for PS Chinook salmon. The effects will degrade the quality of PS Chinook salmon critical habitat PBFs within the action area, reducing conservation values and/or preventing conservation values from being improved. As a result, SRKW critical habitat PBF of prey base will be impaired.

The continued decline and reduced potential for recovery of the PS Chinook salmon is likely to alter the abundance and distribution of migrating salmon and increase the likelihood of localized depletions in prey, with adverse effects on the forage PBF. SRKWs could abandon depleted areas in search of more abundant prey, and end up expending substantial effort only to find depleted prey resources elsewhere.

Accordingly, we consider the combined temporary and enduring effects of the proposed action will create an incremental but chronic diminishment of the water quality, cover, prey forage, and safe migration PBFs for PS Chinook salmon and for the forage prey PBF for SRKW, throughout the new useful life period of this structure.

2.6 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.

The action area, all waters of Puget Sound from Olympia, Washington, at its southern end, to north of Bellingham, Washington, and to, but not including, the Strait of Juan de Fuca, is influenced by actions in the nearshore, along the shoreline, and also in tributary watersheds of which effects extend into the action area. Future actions in the nearshore and along the shoreline of Puget Sound are reasonably certain to include port and ferry terminal expansions, residential and commercial development, shoreline modifications, road and railroad construction and maintenance, and agricultural development. The repair, replacement, construction and removal of bulkheads above the High Tide Line[22] (HTL) that may not require federal authorization will continue. Based on current trends, there could continue to be a net reduction in the total amount of shoreline armoring in Puget Sound (PSP 2018). Changes in tributary watersheds that are reasonably certain to affect the action area include reductions in water quality, water quantity,

[22] The definitions and processes in USACE regulations, including the "high tide line" (HTL) definition at 33 C.F.R. § 328.3, apply to future permitting and other contexts in which jurisdictional determinations are made.

and sediment transport. Future actions in the tributary watersheds whose effects are reasonably certain to extend into the action area include operation of hydropower facilities, flow regulations, timber harvest, land conversions, disconnection of floodplain by maintaining flood-protection levees, tidegates, effects of transportation infrastructure, and growth-related commercial and residential development. Though the existing regulations minimize future potential adverse effects on salmon habitat, as currently constructed and implemented, they still allow systemic, incremental, and additive degradation to occur. Some of these developments will occur without a federal nexus, however, activities that occur waterward of the OHWM or HTL require a USACE permit and therefore involve federal activities.

Development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of marine habitat. Projected changes in nearshore and estuary development based on documented rates of developed land cover change in Bartz et al. (2015) show that between 2008 and 2060, an additional 14.7 hectares of development of shoreline areas and 204 hectares of estuary development can be expected.

Within the freshwater portion of the action area behind the tidegate, non-federal actions are likely to include fertilizer use, riparian degradation (mowing and tree removal), among other activities. Additionally, operation of tidegates will result in continued and blocked access to rearing and spawning habitats in the watershed. Changes in tributary watersheds that are likely to affect the action area include reductions in water quality, water quantity, and sediment transport. Future actions in the tributary watersheds whose effects are likely to extend into the action area include operation of farming equipment, flow regulations, timber harvest, land conversions, disconnection of floodplain by maintaining flood-protection levees, effects of transportation infrastructure, and growth-related commercial and residential development. Some of these developments will occur without a federal nexus; however, activities that occur waterward of the OHWM require a COE permit and therefore involve federal activities, which are not considered in this section.

All such future non-federal actions, in the nearshore as well as in tributary watersheds, will cause long-lasting environmental changes and will continue to harm ESA-listed species and their critical habitats. Especially relevant effects include the loss or degradation of nearshore habitats, pocket estuaries, estuarine rearing habitats, wetlands, floodplains, riparian areas, and water quality. We consider human population growth to be the main driver for most of the future negative effects on salmon and steelhead and their habitat.

The action area is influenced by actions along the shoreline of PS marine waters and actions associated with No Name Slough. Development actions are expected to have adverse impacts on salmon populations, SRKWs, and critical habitat PBFs. These actions have frequently occurred in the recent past, had an effect on the environmental baseline, and can be considered reasonably certain to occur in the future, as a result of current authorizations or permits and continued population growth. When we consider the life of structures in the proposed action, we can anticipate that tidegates, shoreline armoring, and armored dikes are reasonably certain to have a new useful life of roughly 50 years. Thus, to gauge the cumulative effects accurately, we consider the non-federal effects that will occur in the action area within that same timeframe. As mentioned above, human populations are expected to increase within the Puget Sound region, and if population growth trends remain relatively consistent with recent trends, we can anticipate future growth at approximately 1.5 percent per year.[23]

In June 2005, the Shared Strategy presented its recovery plan for PS Chinook salmon and the Hood Canal Coordinating Council presented its recovery plan for Hood Canal summer-run chum salmon to NMFS who adopted and expanded the recovery plans to meet its obligations under the ESA. Together, the joint plans comprise the 2007 PS Chinook and Hood Canal summer-run chum Salmon Recovery Plan. Several not-for-profit organizations, tribes, and local, state and federal agencies are implementing recovery actions identified in these recovery plans.

Multiple non-federal activities are reasonably certain to occur that impact SRKW interactions with vessels in the Salish Sea. These additional actions are designed to further reduce impacts from vessels on SRKW by limiting the potential for interactions including:

1. Washington State law (Senate Bill 5577) established a commercial whale watching license program and charged WDFW with administering the licensing program and developing rules for commercial whale watching for inland Washington waters (see RCW 77.65.615 and RCW 77.65.620). The new rules were adopted in December 2020, and became effective May 12, 2021, and include limitations on the time, distance, and area that SRKW can be viewed within ½ nautical mile, in an effort to reduce vessel and nose disturbance:
    a. The commercial whale watching season is limited to 3 months/year for viewing SRKW closer than ½ nautical mile, and is limited to 4 hours per day in the vicinity of SRKW.
    b. Up to 3 commercial whale watching vessels are allowed within ½ nautical mile of SRKW at a given time, with exclusion from approaching within ½ nautical mile of SRKW groups containing a calf.
    c. Year-round closure of the “no-go” Whale Protection Zone along the western side of San Juan Island to commercial whale watching vessels, excluding a 100-yard corridor along the shoreline for commercial kayak tours.

2. Continued implementation and enforcement of the 2019 restrictions on speed and buffer distance around SRKW for all vessels.

3. Increased effort dedicated to outreach and education programs. This includes educational material for boating regulations, Be Whale Wise guidelines, the voluntary no-go zone, and the adjustment or silencing of sonar in the presence of SRKWs. Outreach content was created in the form of video, online (including social media), and print advertising targeting recreational boaters. On-site efforts include materials distributed at pumpout and re-fueling stations along Puget Sound, during Enforcement orca patrols, and signage at WA State Parks and WDFW water access sites. Additionally, State Parks integrated materials on whale watching regulations and guidelines in their boating safety education program to ensure all boaters are aware of current vessel regulations around SRKW.

4. Promotion of the Whale Report Alert System (WRAS) in Puget Sound, developed by the Ocean Wise Research Institute, which uses on-the-water reporting to alert large ships

[23] https://www.psrc.org/whats-happening/blog/region-adding-188-people-day

when whales are nearby. Reporting SRKW to WRAS is required for commercial whale watching license holders, and on-the-water staff are also being trained to report their sightings.

5. Piloting a new program (“Quiet Sound”) that will have topic-area working groups to lead projects and programs on vessel operations, incentives, innovations, notification, monitoring, evaluation, and adaptive management. This effort was developed with partners including Commerce, WA State Ferries, and the Puget Sound Partnership in collaboration with the Ports, NOAA, and others. Funding is anticipated to be secured in the 2021 state legislative session.

6. Continued promotion of the voluntary “No-Go” Whale Protection Zone along the western side of San Juan Island in R-MA and C-MA7 for all recreational boats—fishing and non-fishing—and commercial fishing vessels (with the exception of the Fraser Panel sockeye and pink fisheries)[24] (Figure 9). The geographic extent of this area will stretch from Mitchell Bay in the north to Cattle Point in the south, and extend offshore ¼ mile between these locations. The voluntary “No-Go” Zone extends further offshore—out to ½ mile—from a point centered on Lime Kiln Lighthouse. This area reflects the San Juan County Marine Stewardship Area[25] extended in 2018 and the full protected area recognized by the Pacific Whale Watch Association[26] and is consistent with that proposed by NOAA Fisheries as Alternative 4 in the 2009 Environmental Assessment on New Regulations to Protect SRKWs from Vessel Effects in Inland Waters of Washington and represents the area most frequently utilized for foraging and socialization in the San Juan Islands. WDFW will continue to work with San Juan County and will plan to adjust their outreach on a voluntary No-Go zone to be consistent with any outcomes of current marine spatial planning processes.

[24] Non-treaty Fraser River Panel commercial fisheries utilize purse seine gear within ¼ mile of San Juan Island and are required to release non-target species (Chinook and coho); (Cunningham 2021).
[25] https://www.sjcmrc.org/projects/southern-resident-killer-whales/
[26] https://www.pacificwhalewatchassociation.com/guidelines/

Figure 9. An approximation of the Voluntary "No-Go" Whale Protection Zone, from Mitchell Bay to Cattle Point (Shaw 2018). See https://wdfw.wa.gov/fishing/locations/marine-areas/san-juan-islands

7. Currently WDFW enforcement boats conduct coordinated patrols with the U.S. Coast Guard, NOAA Office of Law Enforcement, San Juan County Sheriff's Office, Sound Watch, and other partners year-round that include monitoring and enforcement of fisheries and Marine Mammal Protection Act requirements related to vessel operation in the presence of marine mammals throughout Puget Sound. Patrols in the marine areas of northern Puget Sound, particularly MA 7, are specifically targeted to enforce regulations related to killer whales. These patrols will be increased in intensity at times SRKW calves are present. For comparison, in 2017, WDFW Police conducted 55 patrols; in 2018, they conducted 140 patrols; and in 2019 they conducted 105 patrols specific to MA7 during the summer (Cunningham 2021). Outreach and enforcement of vessel regulations will reduce the vessel effects (as described in Ferrara et al. (2017)) of recreational and commercial whale watching vessels in U.S. waters of the action area.

On March 14, 2018, WA Governor's Executive Order 18-02 was signed and it ordered state agencies to take immediate actions to benefit SRKW and established a Task Force to identify, prioritize, and support the implementation of a longer-term action plan needed for SRKW recovery. The Task Force provided recommendations in a final Year 1 report in November 2018.[27] In 2019, a new state law was signed that increases vessel viewing distances from 200 to 300 yards to the side of the whales and reduces vessel speed within ½ nautical mile of the whales to seven knots over ground. SB 5918 amends RCW 79A.60.630 to require the state's boating safety education program to include information about the Be Whale Wise guidelines, as well as all regulatory measures related to whale watching, which is expected to decrease the effects of vessel activities to whales in state waters.

On November 8, 2019, the task force released its Year 2 report that assessed progress made on implementing Year 1 recommendations, identified outstanding needs and emerging threats, and developed new recommendations. Some of the progress included increased hatchery production to increase prey availability. In response to recommendations of the Washington State Southern Resident Killer Whale Task Force, the Washington State Legislature provided approximately $13 million in funding "prioritized to increase prey abundance for southern resident orcas" (Engrossed Substitute House Bill 1109) for the 2019-2021 biennium (July 2019 through June 2021).

On March 7, 2019, the state passed House Bill 1579 that addresses habitat protection of shorelines and waterways (Chapter 290, Laws of 2019 (2SHB 1579)), and funding was included for salmon habitat restoration programs and to increase technical assistance and enforcement of state water quality, water quantity, and habitat protection laws. Other actions included providing funding to the Washington State Department of Transportation to complete fish barrier corrections. Although these measures won't improve prey availability in the near term, they are designed to improve conditions in the long-term.

Notwithstanding the beneficial effects of ongoing habitat restoration actions, the cumulative effects associated with continued development are reasonably certain to have ongoing adverse effects on all the listed species populations addressed in this Opinion. Only improved, low-impact development actions together with increased numbers of restoration actions, watershed planning, and recovery plan implementation would be able to address growth related impacts into the future. To the extent that non-federal recovery actions are implemented and offset ongoing development actions, adverse cumulative effects may be minimized, but will probably not be completely avoided.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. 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

[27] Available at: https://www.https://orca.wa.gov/progress/all-recommendations/, last visited March 30, 2024.

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.

2.7.1 Integration and Synthesis of Effects on Species

PS Steelhead

Puget Sound steelhead are currently listed as threatened. The 2022 biological viability assessment (Ford 2022) identified a slight improvement in the viability of the PS steelhead DPS since the PS steelhead technical review team concluded that the DPS was at very low viability in 2015, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Ford (2022) reported increases in spawner abundance in a number of populations over the last five years, which were disproportionately found within the South and Central PS, SJDF and Hood Canal MPGs, and primarily among smaller populations. The viability assessment concluded that recovery efforts in conjunction with improved oceanic prey availability have resulted in a slight and short-term increasing viability trend for the PS steelhead DPS, although the extinction risk remains moderate (Ford 2022).

Puget Sound steelhead complete much of their early life history in freshwater and do not rely on nearshore areas of Puget Sound for rearing as Chinook and chum salmon do. Steelhead smolts make rapid migrations to the open ocean and generally spend little time in estuary and nearshore environments. In Puget Sound average migration times through Hood Canal and Puget Sound ranged from 1.8 to 12.8 days depending on the stock (Moore et. al. 2015). Since a significant proportion of the effects of the proposed action are primarily enduring effects on the quality and quantity of nearshore and estuarine habitat, PS steelhead are spared from many of the adverse effects, especially the long-term effects. Short-term noise impacts related to construction would likely injure or kill a small number of PS steelhead but not enough to result in any population-level effects. Likewise, fish relocation could injure or kill a very small number of PS steelhead. Considering both short-term and potential long-term impacts, the proposed action would not have any meaningful effects on PS steelhead population abundance, productivity, spatial structure, or diversity. The proposed action would also not appreciably reduce the likelihood of both the survival and recovery of PS steelhead in the wild by reducing their numbers and reproduction.

The remainder of the integration and synthesis will therefore focus on PS Chinook salmon and SRKW.

PS Chinook salmon and SRKW

Puget Sound Chinook salmon are currently listed as threatened with slightly negative recent trends in status over the previous 15 years (Ford 2022). Widespread negative trends in natural-origin spawner abundance across the ESU have been observed since 1980. Productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Although most populations have increased somewhat in abundance since the last status review in 2016, they still have small negative trends over the past 15 years, with productivity remaining low in most populations (Ford 2022). All PS Chinook salmon populations remain well below the TRT planning ranges for recovery escapement levels, and most populations remain consistently below the spawner-recruit levels identified by the TRT as necessary for recovery.

The SRKW DPS is listed as endangered and the overall status of the population is not consistent with a healthy, recovered population. The SRKW DPS is composed of a single population and it has not grown. The biological downlisting and delisting criteria, including sustained growth over 14 and 28 years, respectively, have not been met. Considering the status and continuing threats, the Southern Resident killer whales remain in danger of extinction.

Numerous factors have led to the decline of PS Chinook salmon including overharvest, freshwater and marine habitat loss, hydropower development, and hatchery practices. Adjustments can, and have been made in the short term to ameliorate some of the factors for decline. Harvest can be adjusted on yearly or even in-season basis. Since PS Chinook salmon were listed, harvest in state and federal fisheries has been reduced in an effort to increase the number of adults returning to spawning grounds. Likewise, hatchery management can, and has been adjusted relatively quickly when practices are detrimental to listed species. To address needed improvements in hydropower, NMFS has issued biological opinions with reasonable and prudent alternatives to improve fish passage at existing hydropower facilities. Unlike the other factors, however, loss of habitat quality is much more difficult to address in the short term. Once human development causes loss of habitat quality, that loss tends to persist for decades or longer. As noted throughout this Opinion, future effects of climate change on habitat quality throughout Puget Sound, including around the project site, are expected to be negative.

Modification of nearshore and estuarine habitat in Puget Sound has resulted in a substantial decrease in habitat quantity and quality for PS Chinook salmon. This has coincided in decreased survival at early life history stages and lower population abundance and productivity (Magnusson and Hilborn 2003, Meador 2013). As noted in Section 2.3, this decline in nearshore and estuarine habitat quality and quantity is the result of shoreline modifications such as dikes and tidegates, the filling of estuaries and tidal wetlands, and the loss of blind and open channels. Estuaries have been drained and diked, cutting off their connection to salt water. Installation of tidegates interrupts normal tidal cycles, converting salt marsh into areas with higher freshwater influence.

Once developed, shoreline and estuarine areas tend to remain developed due to high residential, commercial, industrial, and agricultural demand for use of these areas. New development continues and although designs of replacement infrastructure are often more environmentally friendly, replacement of these structures ensures their physical presence will cause adverse effects on nearshore habitat into the future. This is evidenced by the continued requests for consultation on these types of actions. As a result, shoreline development causes a “press disturbance” in which habitat perturbations accumulate without periods of ecosystem recovery. This interrupts the natural cycles of habitat disturbance and recovery crucial for maintenance of habitat quality over time. The general trend of nearshore and estuarine habitat quality is downward and is unlikely to change given current management of these areas.

Habitat modification has caused broad-scale ecological changes, reducing the ability of critical and other habitat to support PS Chinook salmon juvenile migration and rearing. The loss of submerged aquatic vegetation, including eelgrass and kelp, has reduced cover, an important feature of habitat for PS Chinook salmon. Degradation of sand lance and herring spawning habitat has reduced the quantity of the forage for PS Chinook salmon. Construction of tidegate structures throughout Puget Sound has degraded PS Chinook salmon habitat by creating artificial obstructions to free passage, cutting off access to estuarine rearing habitat, as well as other impacts to nearshore habitat. Habitat modifications that have occurred in Puget Sound to date have reduced juvenile survival, and in some cases, have eliminated PS Chinook salmon life history strategies that rely on rearing in nearshore and estuarine areas during early life history.

Given the rate of expected population growth in the Puget Sound area, cumulative effects are expected to result in mostly negative impacts on PS Chinook habitat quality. While habitat restoration and advances in best management practices for activities that affect PS Chinook habitat could lead to some improvement, adverse impacts created by the intense demand for future development is likely to outpace any improvements. Current state and local regulations do not prevent much of the development that degrades the quality of nearshore and estuarine habitats. There is no indication these regulations are reasonably certain to change in the foreseeable future.

The proposed action would reduce abundance and productivity of affected populations of PS Chinook salmon by increasing mortality at the juvenile life stage. The construction phase of proposed action is likely to expose a small number of juvenile PS Chinook salmon to elevated turbidity, other water quality effects, and underwater noise. Underwater noise is expected to have a meaningful adverse effect on normal behavior and this will impact a small number of juvenile PS Chinook salmon. Also, a small number of PS Chinook salmon, and possibly PS steelhead, would be injured or killed during fish relocation. Much more concerning are the enduring effects from habitat modification. This modification would occur through a combination of the loss of nearshore habitat quality caused by the tidegate and shoreline armoring, from the interruption of fish passage caused by the operation of the tidegate, and by retaining what would be saltwater marsh/estuary habitat as agricultural land with low habitat value. The proposed action causes:

Enduring Effects on Nearshore Habitat

- Lowering of beaches/beach erosion
- Reduced SAV
- Loss of prey items for juvenile salmonids
- Increased water and sediment temperature
- Reduced dissolved oxygen
- Salinity changes
- Decreased beach wrack
- Increased predation on juvenile salmonids due to reduced cover

Our quantitative analysis of enduring effects on nearshore habitat using the Puget Sound Nearshore Calculator provided an output of -275 debits (-2.75 DSAYs).

Enduring Effects on Estuary Habitat

- Increased turbidity in front of the tidegate
- Changes in salinity in front of the tidegate

- Impaired fish passage to hundreds of acres of potential estuarine habitat behind the tidegate
- Reduced estuary habitat quantity (changes in channel morphology)
- Increased turbidity and reduced dissolved oxygen in front of and behind the tidegate
- Increased water temperature
- Decreased prey for juvenile PS Chinook salmon behind the tidegate
- Decreased cover for juvenile PS Chinook salmon behind the tidegate

This habitat modification increases mortality at the PS Chinook salmon juvenile life stage and would persist for an additional 50 years as a result of the proposed action. The proposed action would also reduce the spatial structure of the affected populations by retaining what would be saltwater marsh/estuary habitat as agricultural land with low habitat value. As noted earlier, the six Skagit populations of PS Chinook salmon play an important role in conservation of the ESU as a whole.

The enduring effects of the proposed action on productivity and abundance of PS Chinook salmon in turn limits the number of adult PS Chinook salmon available as prey for SRKW over the long-term, as well as causing SRKW to expend energy to seek prey in other locations due to spatial and temporal depletions. These effects of the proposed action are likely to be experienced by all members of this species and would likely result in additional stress and a lower likelihood of survival and reproduction for individual whales in response to decreased prey availability. In addition to reducing the representation of diversity in SRKW life histories, the effects of the proposed action would also reduce resiliency in withstanding stochastic events, and redundancy to ensure there is a margin of safety for SRKW to withstand catastrophic events. Long-term prey reductions affect the fitness of individual whales and their ability to both survive and reproduce. Reduced fitness of individuals increases the mortality and extinction risk of SRKW and reduces the likelihood of recovery of the DPS.

This combination of effects would exacerbate limiting factors identified in the recovery plans for PS Chinook salmon and SRKWs. For SRKWs, loss of prey is one of three major threats identified in this species' recovery plan. The proposed action would degrade the quality of the prey PBF of critical habitat, further reducing available prey (Chinook salmon). For PS Chinook salmon, degraded nearshore and estuary conditions are listed as limiting factors. The proposed actions will exacerbate these factors by degrading or impeding the development of nearshore and estuary habitat essential for the conservation of this species.

The proposed action is also inconsistent with recovery actions identified in the PS Chinook salmon recovery plan. Recovery plans are non-binding documents that in and of themselves, do not create any regulatory requirement. However, these plans contain important scientific information about the subject species, particularly in regards to limiting factors, delisting goals, and actions recommended to help recover species. The following recommend actions from the PS Chinook salmon recovery plan speak to the need to protect or restore habitat:

- Counties should pass strong regulations and policies limiting increased armoring of these shorelines and offering incentives for protection;
- Aggressive protect areas, especially shallow water/low gradient habitats and pocket estuaries, within five miles of river deltas;

- Protect the forage fish spawning areas;
- Maintain the functioning of shallow, fine substrate features in and near 11 natal estuaries for Chinook salmon (to support rearing of fry);
- Maintain migratory corridors along the shores of Puget Sound;
- Maintain the production of food resources for salmon;
- Maintain functioning nearshore ecosystem processes (i.e., sediment delivery and transport; tidal circulation) that create and support the above habitat features and functions;
- Increase the function and capacity of nearshore and marine habitats to support key needs of salmon;
- Protect and restore shallow, low velocity, fine substrate habitats along marine shorelines, including eelgrass beds and pocket estuaries, especially adjacent to major river deltas;

The Skagit Chinook Recovery Plan (SRSC and WDFW 2005) identified delta[28] rearing habitat as a limiting factor for PS Chinook salmon recovery:

> "At contemporary Chinook salmon population levels, limitations in current tidal delta habitat conditions are displacing juvenile Chinook salmon from tidal delta habitat to Skagit Bay habitat, and forcing a change in their life history type from tidal delta rearing to fry migrants. Literature values show that fry migrant survival is one order of magnitude lower than tidal delta rearing individuals."

The proposed action is also inconsistent with recovery actions identified in the SRKW recovery plan. The following recommended actions from the SRKW recovery plan speak to the need to protect and rebuild the salmonid prey base through habitat restoration and/or protection:

> Rebuild depleted populations of salmon and other prey to ensure an adequate food base for recovery of the Southern Residents.
> - Support salmon restoration efforts in the region.
>   - Habitat management.
>   - Harvest management.
>   - Hatchery management.
> - Support regional restoration efforts for other prey species.
> - Use NMFS authorities under the ESA and the MSFCMA to protect prey habitat.

In summary, PS Chinook salmon populations are far from meeting recovery goals and trends in abundance and productivity are mostly negative. Despite the relative healthy abundance and diversity of the Skagit Basin Chinook populations in the ESU, they are at less than 20 percent of their overall recovery goal, and have experienced 15-year declining trends in abundance (Ford 2022). The Skagit populations of PS Chinook salmon are important to the ESU because:

- Fifty percent of the naturally produced fish in the ESU come from these populations.
- They provide an important source population for other struggling populations in the ESU.
- They are critical to ESU-wide life history and genetic diversity.

[28] Delta is synonymous with estuary or slough.

- All of these populations' genetic "baselines" have been relatively unaffected by historic and present hatchery releases.
- They are critical to ESU-wide spatial structure. The Skagit Basin is the most historically diverse watershed and portions of the upper basin still provide relatively good habitat.
- Spawning habitat for the Skagit populations is the most geographically removed from the rest of the ESU which provides protection from stochastic events.

The adverse effects of the proposed action exacerbate a known limiting factor and would result in negative impacts on population abundance and productivity. Given the 15-year declining trends in abundance for these populations, additional loss of abundance and productivity are particularly concerning.

The status of SRKWs is also poor and continuing to decline. SRKW prey is at a fraction of historical levels. Recent authors have concluded that protecting SRKWs appears to be impossible without restoring diminished populations of Chinook salmon. Williams et al. (2024). *See also* Nelson et al. (2024) (whose integrated population models suggest that prey limitations are affecting SRKW recovery). Under the current environmental baseline, nearshore and estuary habitat in Puget Sound cannot support the biological requirements of PS Chinook salmon. This is evidenced by low survival of PS Chinook salmon juveniles in the nearshore of Puget Sound. Fewer populations of PS Chinook contributing to SRKW's prey base will reduce the representation of diversity of life histories, resiliency in withstanding stochastic events, and redundancy to ensure there is a margin of safety for the salmon and SRKWs to withstand catastrophic events. The condition of the environmental baseline is such that additional impacts on the quality and quantity of nearshore and estuary habitat is likely to impair the ability of that habitat to support conservation of these species. The proposed action would reduce abundance and productivity and spatial structure of PS Chinook salmon through a combination of the loss of nearshore habitat quality and by retaining what would be saltwater marsh/estuary habitat as agricultural land with low habitat value. Given the negative trend in status for PS Chinook salmon and the risk that poses for SRKWs, avoiding such negative effects is critically important. Additionally, the quality of nearshore habitat is expected to decline in the future as a result of climate change. For example, increasing sea surface temperatures are expected to negatively affect salmon population viability (Mauger et al. 2015). The proposed action would also exacerbate habitat limiting factors identified by the PS Chinook salmon and SRKW recovery plans and are inconsistent with recovery action listed in these plans. In several other recent biological opinions, NMFS has concluded that a no-net loss approach to enduring effects is necessary to avoid jeopardy and adverse modification of critical habitat, and otherwise conserve nearshore habitat in Puget Sound (NMFS 2020, NMFS 2021, NMFS 2022b). In another recent programmatic biological opinion, the USACE's proposed action requires projects to fully offset their enduring effects on Puget Sound nearshore habitat in order to be potentially eligible to use the programmatic for ESA consultation (NMFS 2022c). Due to demand for future human development cumulative effects on nearshore habitat quality are expected to be mostly negative.

At this critical juncture, when the effects of the proposed action are added to the environmental baseline and cumulative effects, and the status of the species is taken into account, the proposed action would appreciably reduce the likelihood of both the survival and recovery of PS Chinook salmon and SRKWs in the wild by reducing their numbers and reproduction. *See also* Williams et al. (2024) summarizing that while extinction of SRKW may still be prevented, it will require greater sacrifices and protections than would have been the case had threats been mitigated even a decade earlier.

2.7.2 Integration and Synthesis of Effects of Critical Habitat

Critical Habitat is designated for PS Chinook salmon in marine nearshore environments. Throughout the designated area, multiple features of habitat are degraded, but despite such degradation, many accessible areas remain ranked with high conservation value because of the important life history role it plays. Limiting factors (impaired or insufficient PBFs) include riparian areas and LWD, fine sediment in spawning gravel, water quality, fish passage and estuary conditions. Loss of delta and nearshore critical habitat quality is a limiting factor for all PS Chinook salmon.

At the ESU designation scale, the quality of PS Chinook salmon critical habitat is generally poor with only a small amount of freshwater, estuarine, and nearshore habitat remaining in good condition. Most critical habitat for this species is degraded but nonetheless maintains high value for conservation of the species, based largely on its restoration potential. Development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of critical habitat PBFs for PS Chinook salmon.

Critical habitat for the SRKW DPS includes approximately 2,560 square miles of inland waters of Washington in three specific areas including Puget Sound. Within Puget Sound, the quality of critical habitat for SRKWs has been negatively affected by degradation of water quality, vessel noise, and a reduction of prey availability. One of the three PBFs for SRKW critical habitat is prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth. A recent study using an integrated population model to evaluate the relationship between Chinook salmon abundance and demographic rates of SRKWs attempted to update our understanding of a potential causal relationship between prey availability and SRKW population dynamics, and how these relationships may have changed over time. Results suggest that SRKW mortality rates are more strongly associated with Chinook salmon abundance than birth rates. The authors concluded that their findings, combined with previous research, suggest the recovery of SRKWs may be limited by prey availability, and that the current population size appears to be below carrying capacity (Nelson et al. 2024). Yet most wild salmon stocks, including Chinook, which are SRKW preferred prey, are at fractions of their historic levels. For SRKWs, the impact of the proposed action is on the prey PBF. This impact is caused by the combined loss of nearshore habitat quality and access to quality estuarine rearing habitat that results in a reduction in the abundance, productivity and spatial structure of PS Chinook salmon.

Modification of nearshore habitat in Puget Sound has resulted in a substantial decrease in critical habitat quality for PS Chinook salmon. As noted in Section 2.3, shoreline development is the primary cause of this decline in habitat quality. Development includes shoreline armoring, filling of estuaries and tidal wetlands, and construction of overwater structures. Currently, 27 percent of Puget Sound’s shorelines are armored (Simenstad et al. 2011).

Once developed, shoreline areas tend to remain developed due to high residential, commercial, industrial, and agricultural demand for use of these areas. New development continues and although designs of replacement infrastructure are often more environmentally friendly, replacement of these structures ensures their physical presence will cause adverse effects on nearshore habitat into the future. This is evidenced by the continued requests for consultation on these types of actions. As a result, shoreline development causes a “press disturbance” in which habitat perturbations accumulate without periods of ecosystem recovery. This interrupts the natural cycles of habitat disturbance and recovery crucial for maintenance of habitat quality over time. The general trend of nearshore habitat quality is downward and is unlikely to change given current management of these areas.

Nearshore habitat modification has caused broad-scale ecological changes, reducing the ability of critical habitat to support PS Chinook salmon juvenile migration and rearing. The loss of submerged aquatic vegetation, including eelgrass and kelp, has reduced cover, an important PBF of critical habitat for PS Chinook salmon. Degradation of sand lance and herring spawning habitat has reduced the quality of the forage PBF. Construction of bank armoring throughout Puget Sound has degraded PS Chinook salmon critical habitat by creating artificial obstructions to free passage in the nearshore marine area. Habitat modifications that have occurred in Puget Sound to date have reduced juvenile survival, and in some cases, eliminated PS Chinook salmon life history strategies that rely on rearing in nearshore areas during early life history.

Impacts on the survival of individual juvenile PS Chinook salmon, from a combination of these effects to their nearshore critical habitat as well as impeded access to, and the negative impacts to the quality of, estuarine rearing habitat (discussed in the Species section above), translate to a reduction of adult PS Chinook salmon, the prey PBF for SRKW critical habitat. The SRKW’s population has declined in recent years as has the quality of its critical habitat.

Given the rate of expected human population growth in the Puget Sound area, cumulative effects are expected to result in mostly negative impacts on PS Chinook salmon and SRKW critical habitat quality. While habitat restoration and advances in best management practices for activities that affect critical habitat could lead to some improvement of PBFs, adverse impacts created by the intense demand for future development is likely to outpace any improvements. Current state and local regulations do not prevent much of the development that degrades the quality of nearshore critical habitats. There is no indication these regulations are reasonably certain to change in the foreseeable future.

The previous Species section 2.7.2 summarizes the effects of the proposed action on nearshore and estuarine habitat, and the associated effects on species. The estuarine habitat behind the proposed tidegate is not designated as critical habitat for any species. Thus, below, we limit our analysis to how the proposed action affects the PBFs of critical habitat for PS Chinook salmon and SRKW in front of the proposed tidegate. The proposed action would result in some positive as well as a number of adverse effects on the quality of Puget Sound nearshore habitat critical habitat for PS Chinook salmon including:

- Removal of creosote treated piles would improve water quality by removing these chronic sources of contaminants.
- In the short-term, the proposed construction activities will temporarily degrade the free passage PBF by increasing noise.

- Construction of shoreline armoring would prevent development of shoreline vegetation, and impede sediment and organic material supply to beaches and suppress development of SAV.
- Construction of shoreline armoring would cause beach erosion waterward of the armoring, increase sediment, temperature, and reduce invertebrate forage for PS Chinook salmon.
- Construction of shoreline armoring would prevent development of suitable habitat for forage fish spawning and likely reduce abundance and productivity of these important salmon prey items.
- Operation of the tidegate will cause adverse effects on nearshore habitat in front of the tidegate by degrading water quality and altering natural sediment transport processes.

In addition to our qualitative analyses of impacts on critical habitat, our quantitative analysis using the Puget Sound Nearshore Nearshore Calculator provided an output of -275 debits (-2.75 DSAYs).

The effects of the proposed action result in a decrease in critical habitat quality. As explained in Section 2.4, *Effects of the Action*, the future consequences of the proposed action for critical habitat include adverse effects to nearshore habitat caused by the replacement tidegate structure and new and replacement bank armoring which are extending the life of those structures. Those adverse effects include the impacts listed above. These effects represent a loss in critical habitat value for PS Chinook salmon. Although the effects of the proposed action may impact a small area when compared to the critical habitat designation as a whole, these effects are meaningful given the current status of the critical habitat.

The adverse effects on PS Chinook salmon, described in the Species and Critical Habitat sections above, result in a decrease in quality and quantity of the prey PBF of SRKW critical habitat. Given the current status of the SRKW critical habitat, particularly lack of prey, this reduction represents a substantial loss of critical habitat quality.

The adverse effects of the proposed action would exacerbate limiting factors identified in the recovery plans for PS Chinook salmon and SRKWs. For SRKWs, loss of prey is one of three major threats identified in this species' recovery plan. The proposed action would degrade the quality of the prey PBF of critical habitat, further reducing available prey (Chinook salmon). For PS Chinook salmon, degraded nearshore conditions are listed as a limiting factor. The proposed actions will exacerbate this factor by degrading or impeding the development of nearshore critical habitat PBFs essential for the conservation of PS Chinook salmon.

The proposed action is also inconsistent with recovery actions identified in the PS Chinook salmon recovery plan. Recovery plans are non-binding documents that in and of themselves, do not create any regulatory requirement. However, these plans contain important scientific information about the subject species, particularly in regards to limiting factors, delisting goals, and actions recommended to help recover species. The following recommended actions from the PS Chinook salmon recovery plan speak to the need to protect or restore nearshore habitat:

- Counties should pass strong regulations and policies limiting increased armoring of these shorelines and offering incentives for protection;

- Aggressively protect areas, especially shallow water/low gradient habitats and pocket estuaries, within five miles of river deltas;
- Protect forage fish spawning areas;
- Maintain the functioning of shallow, fine substrate features in and near 11 natal estuaries for Chinook salmon (to support rearing of fry);
- Maintain migratory corridors along the shores of Puget Sound;
- Maintain the production of food resources for salmon;
- Maintain functioning nearshore ecosystem processes (i.e., sediment delivery and transport; tidal circulation) that create and support the above habitat features and functions;
- Increase the function and capacity of nearshore and marine habitats to support key needs of salmon;
- Protect and restore shallow, low velocity, fine substrate habitats along marine shorelines, including eelgrass beds and pocket estuaries, especially adjacent to major river deltas;

The proposed action is also inconsistent with recovery actions identified in the SRKW recovery plan. The following recommended actions from the SRKW recovery plan speak to the need to protect and rebuild the salmonid prey base through habitat restoration and/or protection:

> Rebuild depleted populations of salmon and other prey to ensure an adequate food base for recovery of the Southern Residents.
> - Support salmon restoration efforts in the region.
>   - Habitat management.
>   - Harvest management.
>   - Hatchery management.
> - Support regional restoration efforts for other prey species.
> - Use NMFS authorities under the ESA and the MSFCMA to protect prey habitat.

When completing our analysis, we add the effects of the action and cumulative effects to the environmental baseline, and, *in light of the status of the critical habitat*, determine if the proposed action is likely to adversely modify critical habitat. The status of critical habitat for both PS Chinook salmon and SRKWs is poor and continuing to decline. Given the negative trend in the quality of nearshore critical habitat for PS Chinook salmon and the risk that poses for SRWKs, protection of functioning habitat is critically important. The need to protect habitat is expressed in the recovery plan for the Skagit populations of PS Chinook salmon (SSPS 2007). Additionally, the quality of nearshore critical habitat is expected to change for the worse in the future as a result of climate change. For example, increasing sea surface temperatures are expected to negatively affect salmon population viability (Mauger et al. 2015). This means that even if human development in nearshore areas ceased completely, currently well-functioning critical habitat is likely to decline in quality over time. For these reasons, decline in the quality of Puget Sound Chinook salmon and SRKW critical habitat is inconsistent with recovery—and this proposed action contributes to that decline. As a recent author put it, "while extinction of SRKW may still be prevented, it will require greater sacrifices and protections than would have been the case had threats been mitigated even a decade earlier" (Williams et al. 2024).

In summary, the status of critical habitat for PS Chinook salmon is poor and the current quality of PBFs in nearshore areas cannot support conservation of this species. The prey PBF of critical habitat for SRKWs is at a fraction of historical levels. Under the current environmental baseline, the PBFs of critical habitat cannot support the biological requirements of PS Chinook salmon or SRKW. The condition of the environmental baseline is such that additional long-term and chronic negative impacts on the quality of critical habitat PBFs (nearshore habitat for PS Chinook salmon and prey availability for SRKWs) will therefore impair the ability of critical habitat to support conservation of these species. The effects of the proposed action would further reduce the quality and further perpetuate poor conditions of nearshore and estuary PBFs for PS Chinook salmon. Although the nearshore and estuary areas directly affected by the proposed action may seem small when compared to the PS Chinook salmon critical habitat designation as a whole, impacts of this scale are nevertheless consequential at the designation scale given the current status of the critical habitat.

Because of the importance of PS Chinook as part of the SRKW prey base, the impacts of the proposed action on PS Chinook would also reduce prey availability for SRKWs. The proposed actions would also exacerbate habitat limiting factors identified by the PS Chinook salmon and SRKW recovery plans and are inconsistent with recovery action listed in these plans. In other recent biological opinions, NMFS has concluded that a no-net loss approach is necessary to avoid jeopardy of PS Chinook salmon and SRKW and adverse modification of their critical habitat and otherwise conserve nearshore habitat in Puget Sound (NMFS 2020, NMFS 2021, NMFS 2022b). Due to demand for future human development, cumulative effects on critical habitat quality are expected to be mostly negative. When the effects of the proposed action are added to the environmental baseline and cumulative effects, and the status of the critical habitat is taken into account, the proposed action is likely to appreciably diminish the value of critical habitat, as a whole, for the conservation of PS Chinook salmon and SRKWs.

2.8 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's biological opinion that the proposed action is likely to jeopardize the continued existence of Puget Sound Chinook salmon and SRKW and adversely modify the designated critical habitats of these two species. However, the proposed action is not likely to jeopardize the continued existence of PS steelhead.

2.9 Reasonable and Prudent Alternative

A "reasonable and prudent alternative" (RPA) refers to an alternative action identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat (50 CFR 402.02).

As described in the Integration and Synthesis section above, underpinning the jeopardy and adverse modification findings on PS Chinook salmon are the combined, enduring impacts of the proposed action on nearshore and estuarine habitat which, in turn, limit this vital prey resource for SRKW to a level that will jeopardize SRKW and adversely modify its designated critical habitat. The RPA offered here provides an avenue for reducing and offsetting the impacts of the proposed action on nearshore and estuarine habitat to a level that avoids jeopardy and adverse modification to both PS Chinook and SRKW. The RPA comprises a combination of actions necessary to address the combined impacts of the proposed action on nearshore and estuarine habitat that underpin our conclusions.

We have utilized two methods to provide a reliable, well-supported and objective means by which to delineate and measure the RPA. Where applicable, we have used the NHVM Nearshore Calculator, which was used to quantitatively evaluate certain enduring effects of the proposed action. This is a tool that can quantify loss or gain of habitat function. As noted above, as currently designed, the Calculator is not able to take into account all the effects of the action that underpin our conclusions. We have therefore also utilized a best available quantification of offsets for other effect pathways of the proposed action. This quantification was generated by the Skagit Delta TFI, a regional tidegate initiative involving a range of stakeholders including industry, state and federal agencies, with the Swinomish Tribe participating as a non-voting member on the TFI Oversight Committee. The TFI used a science-based methodology to calculate estuary habitat restoration requirements for specific tidegates in the Skagit delta in order to meet Chinook salmon recovery goals.[29] The combination of these methods (NHVM Nearshore Calculator and TFI Agreement) ensures the key effect pathways that underpin our conclusions are able to be delineated and measured for the purposes of the RPA.

The RPA

The RPA requires the applicant to generate a minimum of 275 credits as measured by the NHVM Nearshore Calculator (or equivalent)[30] and to restore a minimum of 8.6 acres of estuary habitat within the Skagit Bay/Padilla Bay area.

NMFS used the Calculator to analyze applicable components of the proposed action and the output was a nearshore habitat function loss equivalent to 275 debits—hence the 275 credit requirement of the RPA. The assumptions and details of the Calculator analysis are set out in Appendices 1 and 2.

Under the TFI Agreement, the credit required to offset the two No Name Slough tidegates being replaced by the proposed action was 8.6 acres (Table 4-2, WWAA et al., 2008). The TFI Agreement described estuarine habitat restoration as “conversion of … delta agricultural lands.”

[29] Progress in meeting the habitat restoration goals was slower than expected (due in part to “interpretation and application” of the TFI Agreement) and it was this, rather than the substantive restoration goals themselves, which led to reinitiation of the biological opinion on the TFI Agreement (*see* Earthjustice letter to NMFS and the USACE, dated September 9, 2021 recommending the suspension of the TFI programmatic Biological Opinion; NMFS letter to the USACE September 29, 2021 recommending the suspension of the TFI programmatic Biological Opinion; and the USACE letter to NMFS on November 3, 2021 suspending the TFI programmatic Biological Opinion).

[30] Any alternative to NMFS's Calculator must be: (1) based on best available science; (2) based on an assessment of nearshore physical and biological features supporting the conservation of ESA listed species affected by the proposed project; and (3) be able to demonstrate equivalency between habitat impacts of the proposed project and conservation offsets offered to compensate for those habitat impacts. NMFS will evaluate any proposed alternative and determine if it meets these criteria.

(WWAA et al., 2008, p. 4-8). Accordingly, the second part of the RPA requires 8.6 acres of estuary habitat restoration.[31]

Before the USACE issues a permit for the proposed action, the applicant must submit its proposal for complying with the RPA to the USACE, and the USACE and NMFS must verify that the proposal complies with the RPA. Specifically, after the USACE receives the applicant's proposal to comply with the RPA, the USACE must respond within 20 calendar days. If the USACE agrees that the proposal complies with the RPA, the USACE shall then submit the proposed plans to NMFS for review. Within 20 calendar days of receipt of a proposed plan, NMFS will reply to the USACE and applicant as to whether the proposed plan meets the requirements of the RPA. A final approved plan for complying with the RPA must be attached to the USACE permit issued for the proposed action and compliance with the RPA must be an enforceable term of the USACE permit. The applicant must implement the plan consistent with the timelines identified in RPA description and the monitoring and reporting requirements below.

The RPA provides for many options by which the applicant can comply with the RPA. Some of the options involve changes to the proposed action and some do not. Because the RPA requires the applicant to generate a minimum of 275 credits as measured by the Calculator and to restore a minimum of 8.6 acres of estuary habitat, compliance must include at least one Credits option and at least one Acres option. This list of options is described in more detail below:

Credits - Option 1: Habitat improvements within DID 12 control
Credits - Option 2: Habitat improvements outside of DID 12 control
Credits - Option 3: Restoration funding
Credits - Option 4: Conservation credit purchase
Credits - Option 5: Project modifications
Acres - Option 1: Habitat restoration
Acres - Option 2: Restoration funding

<u>Options for generating 275 credits</u>

The five options for generating 275 credits (as measured by the NHVM Nearshore Calculator or equivalent) are set out below and these options may be used in any combination with each other to achieve the necessary offsets.

<u>Credits - Option 1: Habitat improvements within DID 12 control</u>

Implement habitat improvements that would result in conservation credits and are within the full discretion and control of DID 12. Improvements that could result in credits include, but are not limited to:

- Remove existing over-water structures or piles;

[31] The TFI calculated a ratio of the habitat restoration target and the base area and applied that ratio (0.04156) to the area influenced by each tidegate. This determined the habitat credit acreage per tidegate. See TFI Agreement (WWAA et al. 2008) p. 4-15. For the tidegates being replaced as part of the proposed action, 207 acres x 0.04156 = 8.6 acres. See Table 4-2 of the TFI Agreement (WWAA et al. 2008).

- Remove derelict structures;
- Remove shoreline armoring;
- Plant or relocate submerged aquatic vegetation (SAV); and,
- Shoreline planting of native (non-submerged) vegetation.

The removal of pilings or overwater structures, or any removal of shoreline armoring that is already included as part of the proposed action has already been accounted for in the Calculator output and thus would not be considered again as an action that would contribute towards compliance with this RPA. NMFS included the removal of two creosote piles in calculating the conservation debits. NMFS did not include the removal of the trash rack in the calculation of conservation debits as this structure is behind the existing tidegate and provides minimal habitat value.

If the applicant chooses Credits - Option 1 to meet required conservation credits in whole or in part, the following is required:

- A Habitat Improvement Plan which must be submitted as part of the proposal for complying with the RPA. The plan must include a description of the type(s) of habitat improvements, including:
    - A quantitative description of habitat improvements relative to the Calculator inputs (e.g., square foot (sq ft) of overwater structure removed, linear foot (lf) shoreline armoring removed, cubic yards of gravel placement);
    - Where the improvements would occur;
    - How the improvements would occur (e.g., any construction type actions); and,
    - When the improvements would occur.
- A Calculator output documenting expected credit generation, which must be submitted as part of the proposal for complying with the RPA.
- Habitat improvement projects must be completed within three years of the project's construction start date.

<u>Credits - Option 2: Habitat improvements outside of DID 12 control</u>

Implement habitat improvements within Skagit Bay or Padilla Bay that would result in conservation credits and are outside DID 12's full discretion and control. Improvements that could result in credits include, but are not limited to:

- Removal of pilings or overwater structures that would reduce the loss of nearshore habitat; and/or
- Remove shoreline armoring to reduce the loss of nearshore habitat.

Habitat improvements proposed by the applicant must be stand-alone projects (e.g., discrete actions such as the removal of a specific number of piles).

If the applicant chooses Credits - Option 2 to meet required conservation credits in whole or in part, the following is required:

- A Habitat Improvement Plan which must be submitted as part of the proposal for complying with the RPA. The plan must include a description of the type(s) of habitat improvements, including:
    - A quantitative description of habitat improvements relative to the Calculator inputs (e.g., sq ft of overwater structure removed, lf shoreline armoring removed, cubic yards of gravel placement);
    - Where the improvements would occur;
    - How the improvements would occur (e.g., any construction type actions); and,
    - When the improvements would occur.
- A Calculator output documenting expected credit generation, which must be submitted as part of the proposal for complying with the RPA.
- A written agreement with any offsite landowner(s), that documents the landowner(s)' consent to the Habitat Improvement Plan, and which must be submitted as part of the proposal for complying with the RPA.
- Land acquisition (if needed) and habitat improvement projects must be completed within three years of the project's construction start date.

Credits - Option 3: Restoration funding

Provide funding to a habitat restoration "sponsor" (i.e., a state agency, Regional Organization, designated Lead Entity, tribal organization, Conservation District or Regional Fisheries Enhancement Group) to support a restoration project that will improve nearshore or estuarine habitat. The project must occur within Skagit Bay or Padilla Bay. One option may be to enter into a revolving restoration agreement with a sponsor, whereby the applicant reimburses the sponsor for completed restoration work (including consideration of inflation, temporary delay between completed and proposed work, and consideration of potential uncertainties), and the funding provided will be used for a future project.

Funding provided under this Option cannot be public funding that was specifically designated for some other purpose by law, regulation, or the rules of a federal or state grant program.

If the applicant chooses Credits - Option 3 to meet required conservation credits in whole or in part, in addition to the bulleted requirements set out above for Option 1, the following is also required:

- Documentation of a presale (or equivalent) agreement between restoration project sponsor and the applicant that identifies the specific name and location of the restoration project, and which must be submitted as part of the proposal for complying with the RPA.
- A Calculator output documenting credits associated with the applicant's funding for the identified restoration project, which must be submitted as part of the proposal for complying with the RPA.
- Written assurances from the restoration project sponsor that the identified restoration project would occur within three years of the full funding transfer/purchase, which also must be submitted as part of the proposal for complying with the RPA.
- Documentation that funds have been paid to the habitat restoration sponsor prior to the project's construction start date.

Credits - Option 4: Conservation credit purchase

Purchase conservation credits from a NMFS-approved conservation bank, in-lieu fee program, and/or crediting provider.

If the applicant chooses Credits - Option 4 to meet required conservation credits in whole or in part, the following is required:

- Documentation of a presale (or equivalent) agreement between credit provider and applicant that identifies the number of credits the applicant intends to purchase, which must be submitted as part of the proposal for complying with the RPA.
- Documentation that credits have been purchased prior to the project's construction start date.

- The Credit provider must use the funds in the service area(s)[32] relevant to Skagit Basin PS Chinook salmon

Credits - Option 5: Project modifications

Project modifications that reduce overall impacts to habitat function and would be implemented as part of the USACE permit for the proposed action. Project modifications that could result in reduced debit or increased credits include, but are not limited to:

- Setback of shoreline armoring landward of the current location
- Removal of creosote piles, in addition to the two pile removals included in the proposed action

If the applicant chooses Credits - Option 5 to meet required conservation credits in whole or in part, the following is required:

- A Project Update, which must be submitted as part of the proposal for complying with the RPA. The plan must include a description of the type(s) of project updates compared to previous proposed action, including:
    - Quantitative description of project changes relative to the Calculator inputs;
    - Where the improvements would occur;
    - How the improvements would occur (e.g., any construction type actions); and,
    - When the improvements would occur.
- A Calculator output documenting expected credit/debit output, which must be submitted as part of the proposal for complying with the RPA.

Options for restoring 8.6 acres of estuarine habitat

[32] A service area is the geographic area in which conservation credits and debits can be traded to offset the loss of service value for listed salmonids. NOAA established five service areas in the Salish Sea. Service areas can be viewed on the Puget Sound Partnership Credit Program (https://www.google.com/url?q=https://www.psp.wa.gov/pspnc.php&sa=D&source=docs&ust=1713388036827956&usg=AOvVaw1SvDQtCqs-yc4BGYgN6BzA) and NOAA's Nearshore web page (https://www.fisheries.noaa.gov/west-coast/habitat-conservation/puget-sound-nearshore-habitat-conservation-calculator) .

The two options for restoring 8.6 acres of estuarine habitat within the Skagit Bay/Padilla Bay area are set out below and these options may be used in any combination with each other so long as taken together they result in a minimum of 8.6 acres of restoration. In the context of this RPA, to restore means to take actions that will have the effect of returning habitat to full estuarine tidal dynamics and to provide complete volitional access by salmonids to this habitat.

Acres - Option 1: Habitat restoration

Restore estuary habitat on land adjacent to an existing distributary channel, main channel, or side channel within the Skagit Bay/Padilla Bay area, which could involve removal of a tidegate to form a restored natural channel.

If the applicant chooses Acres - Option 1 to meet required estuarine restoration, the following is required:

- A Habitat Improvement Plan which must be submitted as part of the proposal for complying with the RPA. The plan must include a description of the proposed restoration, including:
  - A quantitative description of estuarine habitat to be restored;
  - An explanation of how habitat will be returned to full estuarine tidal dynamics and provide complete volitional access by salmonids to the high quality habitat.
  - Where the restoration would occur;
  - How the restoration would occur (e.g., any construction type actions); and
  - When the restoration would occur.
- A pre-sale agreement with the landowner(s) (if restoration is not occurring on applicant-owned land) that documents the intended sale of land to the applicant, which must be submitted as part of the proposal for complying with the RPA. The equivalent could be provided for an easement in perpetuity.
- Off-site land acquisition (or perpetual easement) and restoration must be completed within three years of the project's construction start date.

Acres - Option 2: Restoration funding

Provide funding to a habitat restoration "sponsor" (i.e., a state agency, Regional Organization, designated Lead Entity, tribal organization, Conservation District or Regional Fisheries Enhancement Group) to support a restoration project within Skagit Bay or Padilla Bay that will restore estuarine habitat to fully functioning habitat. One option may be to enter into a revolving restoration agreement with a sponsor, whereby the applicant reimburses the sponsor for completed restoration work, and the funding provided will be used for a future project. Funding provided under this Option cannot be public funding that was specifically designated for some other purpose by law, regulation, or the rules of a federal or state grant program.

If the applicant chooses Option 2 to meet required estuarine restoration, the following is required:

- Documentation of a presale (or equivalent) agreement between restoration project sponsor and the applicant, which must be submitted as part of the proposal for complying with the RPA. The document must identify:
  - A quantitative description of estuarine habitat to be restored;
  - An explanation of how habitat will be returned to full estuarine tidal dynamics and provide complete volitional access by salmonids to the high-quality habitat.
  - Where the restoration would occur;
  - How the restoration would occur (e.g., any construction type actions); and
  - When the restoration would occur.
- Written assurances from the restoration project sponsor that the identified restoration project would occur within three years of the full funding transfer/purchase date, which must be submitted as part of the proposal for complying with the RPA.
- Documentation that funds were paid to the habitat restoration partner prior to the project's construction start date.

<u>General Provisions Applicable to RPA</u>

Any delays in implementation of RPA Options that extend beyond the specified timeframes described in the RPA Options may result in proportional increases in the amount of required mitigation.

For any part of this RPA that requires updated NHVM calculator outputs, NMFS will respond to a request for technical assistance within 10 days of any such request.

RPA implementation options that involve habitat improvement or restoration work being undertaken by the applicant must meet the design, best management practices, and conservation measure requirements established in the Fish Passage and Restoration Action Programmatic Biological Opinion ("FPRP III" WCR-2014-1857). If they do not meet these requirements, such work may be subject to a separate, future ESA consultation. RPA implementation options that involve funding or credit purchases for habitat improvement or restoration work being undertaken by third parties are expected to be covered by a separate existing (NWR-2006-5601) or future ESA consultation. Project modifications made per RPA Credits - option 5 are not expected to result in effects outside the scope of those already considered in this Opinion.

Any time after signature of the final Opinion, NOAA staff (biologist and/or accompanied by NOAA enforcement) may do periodic compliance checks on the project.

RPA Monitoring and Reporting

The following reports are required to document compliance with the terms of this RPA. All reports shall contain the WCRO Tracking number (WCRO-2022-03092) and be sent by electronic copy to NOAA's reporting system email address at: projectreports.wcr@noaa.gov:

a. If the applicant uses Credits - Option 1 (habitat improvements within DID12 control) to meet part of their RPA requirements, applicants shall, within three years from the project's construction start date do the following:
    i. Provide verification, via the RPA Report sheet (Appendix 3) turned in through projectreports.wcr@noaa.gov, that the habitat improvement projects were implemented as proposed. At a minimum this verification should include:
        A. A description of the final design, and
        B. Before and after photographs.

b. If the applicant uses Credits - Option 2 (habitat improvements outside DID12 control) to meet part of their RPA requirements, the applicant shall, within three years from the project's construction start date do the following:
    i. Provide verification, via the RPA Report sheet (Appendix 3) turned in through projectreports.wcr@noaa.gov that the habitat improvement projects were implemented as proposed. At a minimum this verification should include:
        A. A description of the final design, and
        B. Before and after photographs.

c. If the applicant uses Credits - Option 3 (Restoration funding) to meet part of their RPA requirements, the applicant shall, prior to the project's construction start date, provide documentation showing that funds have been paid to the habitat restoration sponsor.

d. If the applicant uses Credits - Option 4 (Conservation credit purchase) to meet part of their RPA requirements, the applicant shall, prior to the project's construction start date, provide documentation showing that credits have been purchased.

e. If the applicant uses Acres - Option 1 (habitat restoration) to meet part of their RPA requirements, the applicant shall, within three years from the project's construction start date do the following:
    i. Provide verification, via the RPA Report sheet (Appendix 3) turned in through projectreports.wcr@noaa.gov, that habitat restoration was implemented as proposed. At a minimum this verification should include:
        A. A description of the final design, and
        B. Before and after photographs.

f. If the applicant uses Acres - Option 2 (restoration funding) to meet part of their RPA requirements, the applicant shall, prior to the project's construction start date, provide documentation showing that funds have been paid to the habitat restoration sponsor.

g. Within 30 days of USACE issuing the final permit, the USACE shall provide NMFS notice and a final copy of the USACE permit to projectreports.wcr@noaa.gov

Compliance of RPA with Regulatory Criteria

The RPA can be implemented consistent with the intended purpose of the action and is consistent with the USACE's legal authority and jurisdiction. The intended purpose of the proposed action as described in the Biological Assessment is to maintain flows through the dike in support of aquatic habitat and the continued use of agricultural lands. The USACE has permitting authority and jurisdiction under the Clean Water Act and the Rivers and Harbors Act and these must be exercised consistent with its obligations and responsibilities under the Endangered Species Act, 16 U.S.C. 1536(a).

The RPA is fully consistent with the purpose of the action and the USACE's legal authorities and jurisdiction. Some of the RPA options allow the USACE to finalize a project permit without any alteration to the proposed tidegate and associated structures, while other options would result in project amendments, for example, by setting back the shoreline armoring or removing additional creosote piles. None of the RPA options are mandatory on their own, and none would require the project to be altered such that it would not allow flows to be maintained through the dike in support of continued agricultural use. All of the RPA options fall within the USACE's authority to permit structures in or over navigable waters and authorize discharge of dredged or fill materials into waters of the United States. In addition, all of the RPA options would maintain, and even enhance, flows in support of the aquatic habitat purpose of the proposed action. The suite of RPA options also appears consistent with the USACE's obligations, when issuing permits under section 404 of the CWA, to minimize harm to the aquatic ecosystem, avoid significant adverse effects on aquatic life and fish habitat, and to comply with the ESA (40 C.F.R. 230.10, 230.30; 40 C.F.R. 230.75), as well as its similar obligations with respect to section 10 of the Rivers and Harbors Act. USACE has express authority to condition permits to ensure compliance with the ESA. 33 C.F.R. 325.4. Although the USACE has primary responsibility for interpreting its authorities, we note that USACE is currently implementing RPAs very similar to this, i.e., WCRO-2020-1361 (NMFS 2020), WCRO-2021-1620 (NMFS 2021), and WCRO-2021-03047 (NMFS 2022b).

The RPA is technologically feasible. As an initial matter, it is relevant that the applicant can satisfy the Credits part of the RPA through a combination of any of the five options and to satisfy the Acres part of the RPA through a combination of the two options. Thus, there is broad flexibility in developing an RPA Plan so if one example suggested in one RPA Option turns out not to be feasible that does not undermine the overall feasibility of the RPA.

With respect to the Credits component of the RPA, conservation credits can readily be obtained through the Puget Sound Partnership (PSP)[33] and the SNNP consultation provides a model for successful utilization of PSP credits to meet mitigation requirements in combination with applicant-responsible restoration projects or project (re)design. NMFS records show that 185 projects have been verified through SSNP to date, with 63 purchasing PSP credits and the balance of credits being generated through applicant-responsible mitigation projects such as pile removal, structure removal, riparian plantings and/or project design modifications.

Regarding technological feasibility of options requiring landowner consent, the County Assessor records indicate that the land on the landward side of the proposed project is owned by the Washington State Department of Fish and Wildlife or the Department of Ecology as are areas marineward of the proposed project[34] (Figure 10). Given the statutory missions of these agencies, this land ownership would suggest the feasibility of RPA Credits-Option 5 (modifying the project to setback the shoreline armoring) and/or Credits-Option 2 (off-site habitat modification).

Figure 10. Land ownership at No Name Slough showing state-owned lands behind the slough.

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[33] NMFS, FWS and PSP are parties to an Memorandum of Understanding which governs the PSP conservation crediting administration in Puget Sound nearshore. Under the MOU, the Services verifies credit calculations for all conservation projects to be funded through PSP before PSP funds the projects. The Services also assess the valuation of credits and debits to ensure the conservation values offset the impacts as analyzed in relevant Biological Opinions. Based on these, and other assurances contained in the MOU, NMFS considers PSP to be a valid conservation credit bank.

[34] https://www.skagitcounty.net/search/property/ (e.g.,property parcel # p21143)

In terms of the feasibility of Acres-Option 1 (habitat restoration), Skagit County Assessor records show that "Dike District No 12" owns 100+ parcels of land, totaling more than 270 acres.[35] If it is Skagit County Dike, Drainage and Irrigation Improvement District 12 (i.e. the applicant) that owns or has the ability to control this land, this could provide opportunities for implementing the RPA without landowner permission or the need to acquire additional land. Some parcels are within the non-tidal delta area identified in the Chinook Recovery Plan as having potential for restoration. *See* Figure 11, below.

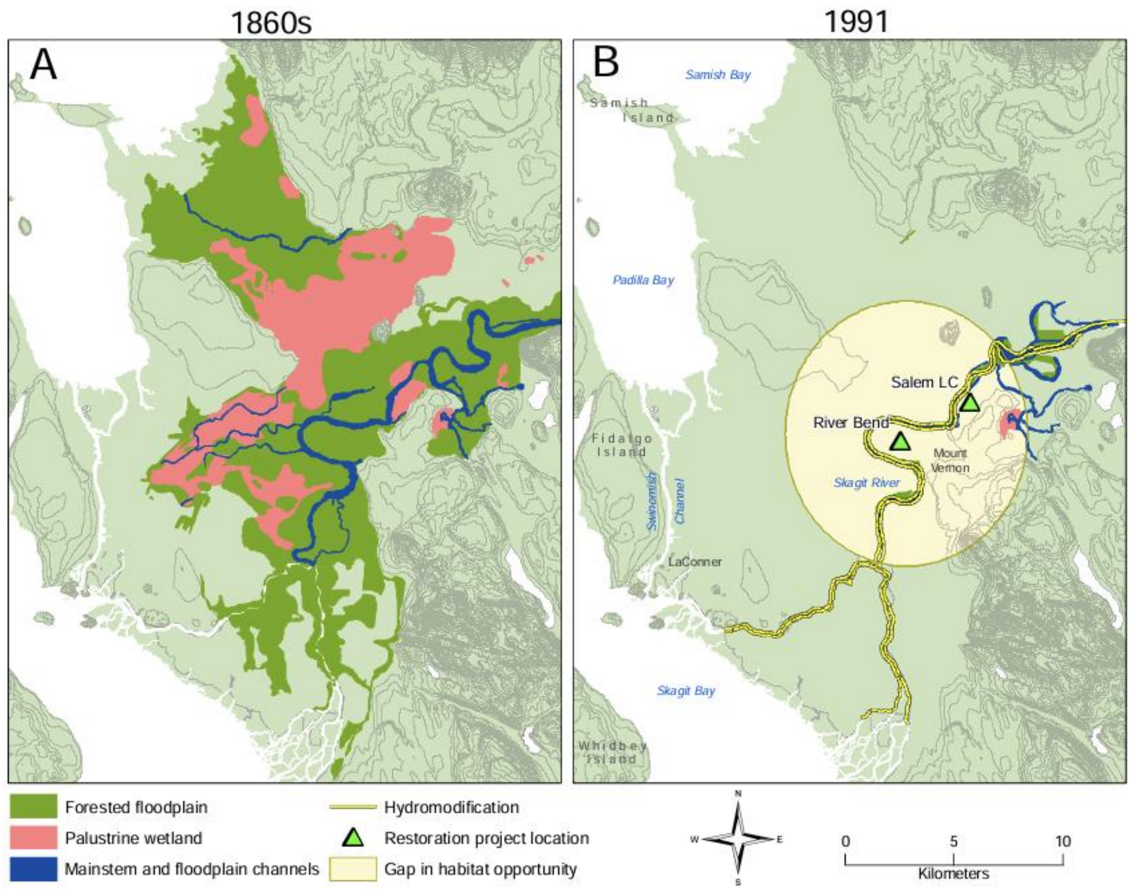

Figure 10.2. *Floodplain areas for the non-tidal delta portion of the Skagit River.* The map shows changes to floodplain and mainstem habitats. Historic conditions (A) were reconstructed by Collins (2000) and current conditions (B) were assessed using 1991 orthophotos by Beamer et al. (2000b).

Figure 11. Skagit Chinook recovery plan (SRSC and WDFW 2005, Figure 10.2) showing an area where there is a gap in habitat opportunity between Sedro-Woolley and the tidal delta.

In terms of project availability, restoration projects in the Skagit Delta have been identified in various documents, involving both nearshore and estuarine habitat. For example, priority restoration projects were specified in the Skagit Chinook recovery plan (SRSC and WDFW 2005) and incorporated into the TFI Agreement (WWAA et al. 2008). Table 9 below lists priority restoration projects for Chinook salmon in the Skagit Delta. The "Estuary Restoration and Strategic Assessment" (ESRA) also identifies priority projects as determined by a coalition

[35] https://www.skagitcounty.net/search/property/

of representatives from salmon recovery, flood risk reduction, and agricultural groups—including three Skagit diking districts.[36] The Salmon Recovery Portal is a mapping and project tracking tool that allows Lead Entities (such as the Skagit Watershed Council) to share habitat protection and restoration projects with funders and the public. The Skagit Watershed Council lists 64 active projects, 5 approved projects, 12 alternate projects, 31 proposed projects, and 81 planned projects.[37]

Many successful restoration sponsors exist in the Skagit delta, including the Skagit River Systems Cooperative,[38] the Skagit Conservation District,[39] the Skagit Fisheries Enhancement Group,[40] and the Nature Conservancy,[41] which has led to many beneficial restoration projects for Chinook salmon.[42] Restoration is commonly a partnership among several restoration practitioners. Entities such as the applicant can, and have, partnered with such entities to implement restoration projects in the Skagit delta. For example, the Fisher Slough restoration project is a freshwater tidal marsh restoration project on the South Fork Skagit Delta. The Nature Conservancy of Washington collaborated with local partners (including Dike District 3 and Drainage and Irrigation District 17) to restore the 60-acre site, including a levee setback, relocating and updating drainage infrastructure, installing fish-friendly tidegates, excavating channels and planting native vegetation.[43]

The feasibility of restoration funding options is enhanced by the prospect of revolving restoration agreements with a sponsor, whereby the applicant reimburses the sponsor for completed restoration work (including consideration of inflation, temporary delay between completed and proposed work, and consideration of potential uncertainties), and the funding provided will be used for a future project. NMFS has recently been involved in a successful instance of such an agreement in the Hood Canal area.

In terms of economic feasibility, the ESA requires only that an RPA "*can be* taken by the Federal agency or applicant." 35 USC 1536(b)(3)(A)(emphasis added). Accordingly, NMFS need only "consider whether its proposed alternative is financially and technologically *possible*," and is "not responsible for balancing the life of the [endangered species] against the impact of [the RPA]."[44] NMFS is also not required to "pick the best option for the industry."[45] Here, it appears

[36] https://wdfw.wa.gov/sites/default/files/2020-02/hdm-ersa_summary_report_web_version.pdf

[37] https://srp.rco.wa.gov/site/280. The lists include estuary, nearshore and freshwater projects.

[38] http://skagitcoop.org/ The Skagit River System Cooperative (SRSC) has completed many estuarine and nearshore restoration projects in the Skagit delta. The Tribes that make up the SRSC (Swinomish and Sauk-Suiattle) have reservations in the Skagit Basin, and treaty rights to fish in their Usual and Accustomed fishing areas. As a Trustee, NMFS observes that the tribes may have a strong interest in habitat restoration.

[39] https://www.skagitcd.org/

[40] https://www.skagitfisheries.org/

[41] https://www.nature.org/en-us/get-involved/how-to-help/places-we-protect/skagit-river/ The Nature Conservancy has completed numerous large-scale estuarine restoration projects, including Port Susan Bay Preserve.

[42] NMFS is providing this information only to demonstrate that there are feasible options for implementing the RPA and does not endorse any particular conservation credit or restoration provider.

[43] https://salishsearestoration.org/wiki/Fisher_Slough_Restoration

[44] San Luis & Delta-Mendota Water Authority v. Jewell, 747 F.3d 581 (9th Cir. 2014).

[45] DOW v NMFS, 2013 WL 632857 (C.A.4 (Md.) citing Greenpeace v. Nat'l Marine Fisheries Serv., 55 F.Supp.2d 1248, 1268–69 (W.D.Wash.1999).

in this case that the RPA options NMFS has provided are economically "possible" for the applicant.

As noted above, there appears to be publicly owned land adjacent to the project site, and the applicant appears to own land with restoration potential, both of which would reduce the cost of restoration projects. The County Assessor website also shows that privately held land inland from No Name Slough has a market value of about $7,000 per acre, such that 8.6 acres would cost approximately $60,000. In addition, the balance sheet for the applicant (Skagit County Dike, Drainage and Irrigation Improvement District 12) shows a total of $19,066,157 in cash and investments (Skagit County Audit report published October 2023).[46] Although the relevance of DID 12's drainage budgets and diking budgets (>$2.5 million annually[47]) in relation to the proposed action are unclear, we note that diking and drainage districts have the authority and ability to collect levies/assessments (RCW 85.18.010; RCW 85.06) and that District 12's drainage and diking assessment areas both include No Name Slough.

Regardless of which options the applicant chooses, compliance with this RPA is expected to avoid jeopardy and adverse modification while allowing the project to achieve its intended purpose. In the following paragraphs we explain how implementing this RPA would ensure that the proposed action would avoid the likelihood of jeopardizing the continued existence of PS Chinook salmon and SRKW, as well as avoid the likelihood of destruction or adverse modification of their critical habitats.

[46] Audit report published October 2023.
https://portal.sao.wa.gov/ReportSearch/Home/ViewReportFile?arn=1033364&isFinding=false&sp=false
[47] https://skagitcounty.net/Assessor/Documents/2024%20Levy%20Rate%20Sheet.pdf

Table 9. Priority restoration projects identified by the Skagit River System Cooperative and the Washington Department of Fish and Wildlife (SRSC and WDFW 2005). NMFS notes that some of the priority restoration projects in this table have since been implemented.

Water Body	Restored Area (acres)	Restored Channel Area (acres)	Smolts Produced	Smolts per Acre
NORTH FORK SETBACK	658	30	625,032	950
CROSS ISLAND CONNECTOR	472	36.1	264,486	560
RAWLINS ROAD	178	9.8	95,000	533
S. FORK DIKE SETBACK	39.5	0.92	14,588	508
DEEPWATER #2	268	11	95,516	356
THEIN FARM	84.5	2.5	30,000	355
SMOKEHOUSE/FORNSBY 1	62	6.4	20,471	344
MILL TOWN	212	14.8	57,179	330
FISHER SLOUGH	68	2	16,431	269
WILEY SLOUGH	160	7	54,989	241
TELEGRAPH #2	487	37	113,145	232
SMOLT PRODUCTION GOAL MET	**2689**	**157.52**	**1,386,837**	
TELEGRAPH SLOUGH #1	222	17.3	50,000	225
SULLIVAN HACIENDA	196.7	5.8	36,517	185
SMOKEHOUSE/FORNSBY 2	93	3.5	10,890	171
DAVIS/DRY SLOUGH	119	4.7	20,297	117
BLAKES BOTTLENECK	18.5	0.2	1,780	96
MCGLINN CAUSEWAY	No Data	No Data	40,898	0
ADDITIONAL SMOLT PRODUCTION	**649.2**	**31.5**	**119,484**	**794**
Yellow = completed estuary restoration projects				
Green = estuary restoration projects in progress				
Pink = smolt recovery goal achieved per Skagit Chinook Recovery Plan = 1,350,000				

Effects of the Proposed Action as Modified by the RPA on PS Chinook salmon and their Critical Habitat

The jeopardy and adverse modification findings for PS Chinook salmon are premised on the enduring impacts of the proposed action to nearshore and estuarine rearing habitat for an additional 50 years. PS Chinook salmon juvenile survival is directly linked to the quality and quantity of nearshore and estuary habitat and there is higher juvenile survival in areas where there is a greater abundance and quality of estuary and nearshore habitat. PS Chinook habitat quality and quantity is currently insufficient to support conservation of this ESU. The proposed action's combined impacts on nearshore and estuarine habitat would further worsen or perpetuate these conditions and are inconsistent with the species' recovery.

The proposed action, as modified by the RPA, avoids jeopardy and adverse modification of critical habitat for PS Chinook salmon, despite climate change effects, because it directly addresses the habitat impacts that give rise to our jeopardy and adverse modification conclusions by requiring a combination of habitat offsets for impacts to critical habitat in the nearshore and restoration of currently degraded estuarine rearing habitat. These RPA requirements will ensure that limiting factors (degraded nearshore conditions and estuarine habitat loss) and the PBFs (water quality, forage, natural cover and free of excessive predation) of PS Chinook salmon critical habitat will not continue to worsen as a result of the proposed action.

All of the Options for generating credit offsets are designed to address the enduring adverse impacts of the proposed action by generating long-term positive effects to species and critical habitat. These activities are reasonably certain to lead to some degree of ecological restoration, including the establishment of environmental conditions associated with functional nearshore and estuary habitat. For example, the types of actions that could be carried out to generate credits will improve habitat quality for PS Chinook salmon. Removal of over-water structures reduces shade and decreases predation on juvenile salmonids; removal of in-water structures such as treated-wood piles removes habitat for piscine predators and eliminates persistent sources of contaminants; the purchases of conservation bank credits will result in improved habitat quantity or quality and, by definition, it will be of ecological relevance to comply with the RPA; and, project modifications that satisfy the RPA will inherently have reduced impacts on nearshore habitat.

Restoration of estuarine habitats in the Skagit Delta over the past 20 years has also repeatedly demonstrated that such actions are effective in increasing PS Chinook salmon abundance and productivity. As a result of restoration activities designed to reverse the loss of tidal marsh habitat in Wiley Slough in 2009, setbacks of dikes and levees increased 156 acres of tidal salt marsh habitat, providing rearing habitat for hundreds of thousands of juvenile Chinook salmon (WDFW 2023). In an additional example, dike setbacks restored 45 acres of estuarine habitat in Fisher Slough, which produced notable improvement in water quality and increased PS Chinook smolt abundance by more than 21,000 fish (Beamer et al. 2014).

Stabilizing the limiting factors of PS Chinook salmon in the context of this consultation will help allow the expected benefits from other efforts such as modified harvest management, hatchery reform and production from conservation hatcheries, improved fish passage at dams, and freshwater habitat restoration to have a meaningful, positive impact on PS Chinook salmon abundance, productivity, spatial structure, and diversity and their related critical habitat.

Although we expect some delay in the ecological benefits associated with some aspects of the RPA, that does not undermine our conclusion that the proposed action as modified by the RPA avoids jeopardy and adverse modification. For example, nearshore habitat improvement and estuarine restoration projects must be completed within three years of the project's construction start date and funded restoration projects must occur within three years of the full funding transfer/purchase date. These expected time delays in achieving conservation benefits are acceptable because significant evidence supports our assumption that ecosystem improvements in nearshore and intertidal environments will occur rapidly once restoration is complete. For example, Lee et al. (2018) documented strong and positive biotic restoration response within one year of the removal of shoreline armoring. Following significant estuary restoration in the Nisqually River delta, salmon catch data indicated that smolts were using this newly accessible habitat as early as one-year post-restoration (Ellings et al. 2016). Even though there will be a short delay in achieving benefits, the benefits will accrue in the first few years of what would otherwise be 50 years of impacts.

We also do not expect impacts from restoration activities implemented pursuant to the RPA to undermine our conclusion that the proposed action as modified by the RPA will avoid jeopardy and adverse modification. The precise habitat improvement and restoration activities associated with the RPA have yet to be determined. However, based on the limitations written into the RPA, we anticipate that restoration actions will meet the design, best management practices, and conservation measure requirements of FPRP III and fall within the effects analysis of that opinion, or be subject to separate future ESA consultations. RPA implementation options that involve funding or credit purchases for habitat improvement or restoration work being undertaken by third parties are expected to be covered by a separate existing or future, ESA consultation. In general, the very purpose of the activities, i.e. habitat improvement and restoration, is expected to limit the scope and scale of any adverse effects and provide overall beneficial effects. Thus, habitat improvement and restoration activities carried out pursuant to the RPA are likely to be in the environmental baseline and/or have some short-term impacts, but none that will have long-term adverse effects on PS Chinook salmon or be severe enough to impair the ability of habitat to support recovery.

Effects of the Proposed Action as Modified by the RPA on SRKW and their Critical Habitat

At the foundation of the jeopardy and adverse modification finding for SRKW is the reduced survival of juvenile Puget Sound Chinook salmon that will in turn limit this vital prey resource for SRKW. The status of SRKWs and their critical habitat is poor and continuing to decline. SRKW prey is at a fraction of historical levels. Continued negative impacts on prey availability for SRKWs is likely to impair the ability of critical habitat to support conservation of these species. The result of the proposed actions would further reduce the quality and further perpetuate poor conditions of nearshore and estuarine habitat for PS Chinook salmon and, because of the importance of PS Chinook as part of the SRKW prey base, the impacts of the proposed action on PS Chinook would further reduce prey availability for SRKWs.

The proposed action, as modified by the RPA, avoids jeopardy and adverse modification of critical habitat for SRKW, despite climate change effects, because it directly addresses the prey base impacts that give rise to our jeopardy and adverse modification conclusions. It does this by requiring a combination of habitat offsets for impacts to PS Chinook critical habitat in the nearshore and restoration of impeded access to estuary rearing habitat for PS Chinook salmon. These RPA requirements will ensure that limiting factors of PS Chinook salmon critical habitat will not continue to worsen as a result of the proposed action. Stabilizing the limiting factors of PS Chinook salmon in the context of this consultation will help allow the expected benefits from other efforts such as modified harvest management, hatchery reform and production from conservation hatcheries, improved fish passage at dams, and freshwater habitat restoration to have a meaningful, positive impact on PS Chinook salmon abundance, productivity, spatial structure, and diversity and their related critical habitat. In turn, this addresses SRKW's critical habitat requirement for prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth. The RPA avoids further reductions in SRKW prey that would otherwise be caused by the proposed action.

The USACE's Implementation Decision

Because this Biological Opinion has found jeopardy to PS Chinook salmon and SRKW, and destruction or adverse modification of PS Chinook salmon and SRKW designated critical habitat, and offers a reasonable and prudent alternative to avoid jeopardy and adverse modification of critical habitat, the USACE is required to notify NMFS of its final decision on whether it will implement the RPA (50 CFR 402.15(b)).

2.10 Incidental Take Statement

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit 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). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "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 Incidental Take Statement (ITS).

2.10.1 Amount or Extent of Take

In this Opinion, including actions associated with implementation of the action as modified by the RPA, NMFS determined that incidental take is reasonably certain to occur as:

- Capture and relocation of a small number of juvenile PS Chinook salmon and PS steelhead during work area isolation.
- Harassment of juvenile PS Chinook salmon and PS steelhead resulting from construction-related noise
- Harm of juvenile PS Chinook salmon and PS steelhead resulting from increased predation risks, and reduced access to prey (forage), associated with the shoreline modifications;
- Harm of juvenile and adult PS Chinook salmon and PS steelhead resulting from impeded access to, and degradation of estuarine habitat, including from high water temperatures, low dissolved oxygen, salinity changes, and reduced forage; and,
- Harm of SRKW as a consequence of diminishment of their preferred prey, PS Chinook salmon

NMFS anticipates that up to 100 juvenile PS Chinook salmon and steelhead will be captured annually during fish relocation associated with work area isolation. Less than 5% of these fish are expected to die.

NMFS cannot predict with meaningful accuracy the number of listed species that are reasonably certain to be injured or killed by exposure to the remaining stressors. The distribution and abundance of the fish that occur within the action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by a proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action. Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts.

Similarly, NMFS is unable to reliably quantify and monitor the number of individual SRKWs that may be harmed by the incidental take identified here.

In such circumstances, NMFS uses the causal link established between the activity and the likely extent of timing, duration and area of changes in habitat conditions to describe the extent of take as a numerical level. Many of the take surrogates identified below could be construed as partially coextensive with the proposed action; however, they nevertheless function as effective re-initiation triggers. If any of the take surrogates established here are exceeded, they are considered meaningful reinitiation triggers because the USACE has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4), and exceeding any of the surrogates would suggest a greater level of effect than was considered by NMFS in its analysis.

Harassment from Temporary Effects

PS Chinook salmon (juvenile) and PS steelhead (juvenile) will be harassed by construction-related noise resulting from vibratory pile driving. Disruption of normal behavior patterns including feeding and migration, can occur from this exposure. Additionally, implementation of the RPA may result in additional removal of creosote piles. The amount and extent of short-term take resulting from the proposed action, including actions taken to implement RPA, are accounted for and exempted in this take statement.

The duration of vibratory sheet pile driving per day (minutes) is the best available surrogate for the extent of take from exposure to pile removal and installation-related noise. Although the BA did not specify the expected duration of the proposed pile driving, NMFS assumes, based on prior experience, that vibratory pile driving to remove the two piles and install sheet piling will take no longer than 4 hours a day for 3 days. Thus, the maximum number of minutes of vibratory pile driving will be 720 minutes.

The surrogates for take caused by underwater sound generated by pile driving is proportional to the anticipated amount of take. This surrogate is also the most practical and feasible indicator to measure. In some cases, persistent noise can make an affected area inhospitable for normal behaviors such as migrating and foraging. The duration of this disturbance is related to the number of animals potentially affected as well as the intensity of the disturbance. As the duration of noise increases, a larger number of animals migrating or traveling through the affected area are likely to be exposed. Likewise, the longer the noise persists, the longer the affected area may remain incapable of supporting the normal behaviors of salmon and steelhead.

Harm from Enduring Effects

PS Chinook salmon (juvenile), PS steelhead (juvenile), and SRKW will be harmed by the reduction in the quantity and quality of nearshore habitat resulting from shoreline armoring components of the proposed action. More specifically, shoreline modifications are reasonably certain to cause increased predation risk, and reduced forage opportunities for PS Chinook salmon and PS steelhead. In addition, the shoreline modifications impede juvenile PS Chinook salmon and steelhead from entering historical habitat to access prey and refugia from predators, and causes harm related to temperature, dissolved oxygen, and salinity changes. The proposed action is also reasonably certain to cause harm as a result of degradation of estuarine habitat, including from high water temperatures, low dissolved oxygen, salinity changes, and reduced forage. For SRKWs, the impact of the habitat-related effects is related to the reduction in prey, which in turn is caused by the loss of nearshore habitat and access to estuarine habitat that results in a reduction in the abundance of their preferred prey, PS Chinook salmon.

The physical extent (length and width) of shoreline armoring, and placement on the shore below the HAT is the best available indicator for the extent of take from all the take pathways associated with the enduring effects of shoreline modifications.

Shoreline armoring restricts natural beach forming processes (natural erosive processes) by disrupting the supply and replenishment of sediment sources that are the base of forage fish spawning habitat (effects described in Section 2.4.3). As forage fish reproduction is restricted or reduced, so is the availability of food for listed salmon, limiting and reducing the numbers of listed fish that the action area can support. In turn, this limits the number of juvenile PS Chinook salmon that will survive and return to the Puget Sound as adults that supply prey for SRKW. The loss of natural sediment deposition along the shoreline north and south of a structure that supports forage fish and other intertidal and nearshore habitat function are directly proportional to the physical area, length and width of shoreline armoring, and placement on the shore below the HAT. As the length and width of the armoring increases so does impact to sediment inputs. Structures that are placed below the HAT directly eliminate forage fish habitat and feeding habitat for listed species. The further a structure is placed below HAT, the greater the loss of this habitat and thus impacts. There are also correlations between the extent of shoreline armoring and increased predation risks. For instance, shoreline armoring prevents the development of SAV, which juvenile PS Chinook salmon use as cover to hide from predators.

The loss of historical rearing habitat behind the tidegate and shoreline armoring is directly proportional to the rearing productivity of PS Chinook salmon. As the length and width and physical location of the shoreline modifications increases or changes, so does impact on juvenile salmon. For example, the further a structure is placed waterward of HAT, the greater the loss of this habitat and thus effects on juvenile PS Chinook salmon productivity. Thus, the physical extent (length and width) and the physical location of shoreline modifications is also the best available indicator for the extent of take from decreased estuarine habitat quantity and function caused by these structures.

The harm to SRKWs is caused by the reduction in PS Chinook prey which is in turn caused by the enduring loss of nearshore habitat quality and quantity that results in a reduction in the abundance of their preferred prey, PS Chinook salmon. Therefore, the surrogate for SRKW harm is also the physical extent (length and width) of shoreline modifications.

The surrogate of the physical extent (length and width) of shoreline armoring to be constructed, along with the physical location of the proposed tidegate to be constructed, can be reasonably and reliably measured and monitored because of reporting requirements applicable to project construction and will serve as a meaningful reinitiation trigger due to USACE's enforcement authorities.

2.10.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take under the RPA, coupled with other effects of the proposed action, is not likely to result in jeopardy to PS Chinook salmon, PS steelhead, or SRKW, or the destruction or adverse modification of PS Chinook salmon or SRKW critical habitat.

2.10.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" (RPMs) are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The following measures are necessary and appropriate to minimize the impact of incidental take of listed species from the proposed action. The Corps or applicants shall:

1. minimize incidental take from construction related noise resulting from exposure to pile driving and removal activities;

2. minimize incidental take from nearshore habitat loss associated with shoreline armouring;

3. minimize incidental take from passage impediments caused by the tidegate and associated shoreline armoring;

4. implement monitoring and reporting programs to confirm that the RPA and RPMs are implemented as required and take exemption for the proposed action is not exceeded, and that the terms and conditions are effective in minimizing incidental take.

2.10.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The [name Federal agency] or any applicant 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 (pile driving and removal activities). To minimize incidental take from sheet pile installation and removal the USACE shall require the applicant to:
    a. Utilize vibratory pile driving whenever sediment conditions allow.
2. The following terms and conditions implement RPM 2 (minimize incidental take from nearshore habitat loss caused by shoreline armoring). To minimize incidental take from nearshore habitat loss:
    a. The USACE shall require the applicant to immediately report any noncompliance with applicable design criteria or other requirements related to scope or placement of the shoreline modifications to NMFS (projectreports.wcr@noaa.gov) and the Corps. The requirement to report noncompliance applies to all activities caused by this action.
    b. The USACE shall include compliance with the proposed action and this incidental take statement and the reasonable and prudent alternative of this Opinion as a condition of the USACE permit for this project.
3. The following terms and conditions implement RPM 3 (impaired passage through tidegate). To minimize incidental take from tidegate operations the USACE shall require the applicant to:
    a. achieve maximum average velocity releases from the tidegates between 2-4 ft per second.
4. The following terms and conditions implement RPM 4 (Monitoring and Reporting). The USACE shall require the applicant to:
    a. Before work begins, all contractors working on site must receive a complete list of the USACE permit special conditions, the USACE best management practices listed above in the Proposed Federal Action section of this document, this Biological Opinion's RPA (and applicant's plan for complying with the RPA), and the ITS, including the RPMs and terms and conditions intended to minimize the amount and extent of take resulting from in-water work.
    b. On the start date of the construction, the applicant (or designated agent) shall notify NMFS, via projectreports.wcr@noaa.gov, that construction has commenced and include:
        i. Email subject line: "NOTIFICATION OF START DATE **WCRO-2022-03092"**

ii. Date project construction began
iii. USACE NWS project number
iv. A written verification that all USACE-required best management practices (including implementation of a MMMP) are being implemented.

c. Within 60 day of the project being completed, the USACE shall require the applicant to prepare and send to NMFS a project completion report containing the following information:
   i. Starting and ending dates for project construction
   ii. Number of fish relocated during work area isolation
   iii. Minutes per day of vibratory pile driving
   iv. Final length (linear feet) and width (square feet) and location of installed shoreline armoring
   v. A fish salvage report of the work in any dewatered area. It should outline species, number, length, and condition of fish entrapped. If no fish were captured, this aspect of the report may identify "NONE."
   vi. Photo documentation:
      1. Include photos of habitat conditions before, during, and after construction
      2. Label each photo with date, time, and location
   vii. Submit Reports. All reports shall contain the NMFS Number **WCRO-2022-03092** and be sent by electronic copy to NOAA's reporting system email address at: **projectreports.wcr@noaa.gov.**

2.11 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).

To address the poor passage of fish at tidegates, we recommend that the Corps require the applicants to work with state and federal agencies to implement the following:

- Develop a study plan to better understand how fish passage could be improved at tidegates on the Skagit delta. We recommend that any study be coordinated with the NMFS, EPA, WDFW, SRSC, and Ecology, and that the study results be reported to NMFS and the Corps as they become available;
- Develop a comprehensive and programmatic agreement to achieve the overarching goals of the former TFI agreement;
- Use bioengineering to add large wood to shoreline armoring structures;
- Plant marine tolerant riparian vegetation to increase shade to No Name Slough;
- Develop and implement a water quality management plan to improve conditions in No Name Slough and No Name Creek.

2.12 Reinitiation of Consultation

This concludes formal consultation for the Corps' permitting of the No Name Slough Tidegate Replacement project from DID 12 in Skagit County, Washington (NWS-2020-195).

Under 50 CFR 402.16(a): "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: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If 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 written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified 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 Corps and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council (PFMC 2005), coastal pelagic species (CPS) (PFMC 1998), and Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The environmental effects of the proposed action may adversely affect EFH for Pacific Coast salmon and coastal pelagic species EFH, all of which are present in the action area. The action area also contains Habitat Areas of Particular Concern (HAPC) for Pacific Coast salmon in marine portions of the action area. Impacts to EFH include blocked access to rearing and spawning habitats, increased predation and reduced forage from structures placed in the nearshore environment, and benthic disturbance by structures, sediment quality degradation by re-suspended contaminants, and water quality degradation (temperature, dissolved oxygen, and turbidity).

3.2 Adverse Effects on Essential Fish Habitat

The features of EFH of Pacific Coast salmon and coastal pelagic species would include diminishments in water quality, sediment quality, forage. These effects would occur within PS to varying degrees. Additional effects to EFH could occur in freshwater for Pacific Coast salmonids, with disruption of spawning areas. These adverse effects are associated with the habitat impacts of tidegate and shoreline armoring structures in the PS.

As a result of blocking access to spawning and rearing habitat, we anticipate the following habitat effects:

- A 50-year reduction of production potential of PS salmonids;
- A 50-year reduction of Pacific Coastal Pelagic species potential in the nearshore

As a result of the construction, persistence, and operation of the Skagit diking and drainage district tidegates, including maintenance activities, we anticipate the following habitat effects:

- A 50-year reduction of delta rearing habitats for PS salmonids
- A 50-year reduction of foraging habitat for PS salmonids
- A 50-year reduction in spawning and rearing habitats for Pacific Coastal Pelagic forage species along the shoreline.

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.

1) To address the habitat effects of shoreline armoring, we recommend that the Corps require the applicant to implement the following:
    a. Incorporate landscape planning into remedies that increase the availability of rearing habitat in the Skagit Delta by continuing to work with the conservation community to locate and fund restoration activities in these environments;
    b. Develop mitigation banking opportunities in the Skagit Delta by working with County officials and the conservation community.

2) Use soft approaches (e.g., beach nourishment, vegetative plantings, and placement of LWD) in lieu of “hard” shoreline stabilization and modifications (such as concrete bulkheads and seawalls, concrete or rock revetments).

3) Plant shade-producing riparian trees and shrubs and ensure long-term survival by monitoring and adaptively managing survival and productivity. Take corrective action as needed.

4) Based on the information collected through the implementation of conservation measures 1 and 2 above, work with state agencies, and the conservation community, and NMFS to develop new or modified BMPs that further reduce adverse habitat effects of tidegate structures and operations.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, for Pacific Coast salmon and coastal pelagic species.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Corps must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of 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 Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The 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.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion is the Corps. Other interested users could include permit applicants, citizens of affected areas and others interested in the conservation of the affected ESUs/DPS. Individual copies of this opinion were provided to the Corps. The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

Appendix 1. Documentation for No Name Slough Tidegate Calculator

Version 1.6 2024

Summary:

Quantification of impacts within the Nearshore Calculator were limited to the footprint of the hard shoreline armoring (including the tidegate). We ran the Nearshore Calculator with specific adjustments for habitat with estuarine characteristics as outlined below.

Results:

Long term habitat impact: **-2.75 DSAYs or-275 Mitigation Points**.

Introduction:

The Nearshore Calculator Version 1.6 makes it easy for standard users to enter shoreline armor installation in wave-exposed beach habitat. For beach habitat, the Nearshore Calculator determines affected areas based on standardized beach slopes (Cereghino et al. 2023). Using the Nearshore Calculator in habitat with estuarine characteristics like tidal channels, requires site-specific adaptations.

The area where work is proposed is located in an old river channel and shows some characteristics of both wave-exposed beach and estuary with tidal channels. The subject site has some wave exposure and no appreciable drift which is typical for lower energy estuarine sites.

We adjusted the Calculator to consider these site conditions by not relying on beach slopes for selecting affected areas. Instead, we used the site-specifically adjusted Nearshore Calculator for the determination of impacts from the footprint of the dike. Site specific adjustments included selecting site conditions where large woody material is of little relevance for forage and cover (ShorelStabiliz USZ install tab F41-43).

We entered the shoreline armoring and tidegates as armor replacement with removal credits. Removal credits are typically provided under the assumption that the replaced structure will have approximately 10 more years of useful life. Here the District and the Corps provided information and assertions to support this assumption.

We are not considering sea level rise for this assessment as this assessment quantifies the footprint of the armoring only. This assessment does not quantify impacts landward of the shoreline armoring (see Dike and Drainage Maintenance in Section 2.9). Sea level rise would not affect the footprint of the armoring.

Two creosote piles were entered as removed in the *Overwater Structure* tab. Project conditions considered for quantification of impacts and benefits with the Nearshore Calculator are documented in the ProjectD tab.

Entry of the affected area:

ShorelStab tab length of structure is shown in C32&33 and linked from the *ProjectD* tab.
ShorelStabiliz USZ install tab: We entered the 66 feet width of the dike (as measured using Google Earth, 2021 imagery) in USZ2 cell D31 and D34.
ShorelStabiliz USZ remove tab: We entered the 66 feet width of the dike in USZ2 cell C31 and 34.

Local scour effects waterward of shoreline armoring on sediments are linked to reduced epibenthic prey production immediately water-ward of hard armoring in both nearshore (Dugan et al. 2008) and estuarine environments (Morley et al. 2012; Munsch et al. 2017; Sobocinski et al. 2010; Toft et al. 2010). However, w*e based quantifications in the current Nearshore* Calculator on information for beach-type environments, subject to wave action. As such, the Calculator typically includes calculations of adverse effects waterward of hard armoring within an area extending up to 20 feet from the toe of the armoring (Ehinger et al. 2023 Appendix D).

Because the current project is located in an area that shows estuarine conditions (tidal channels), and wave action effects are low, and the Calculator is not yet able to quantify the marineward extent of the adverse impacts extending out from the armoring in this type of environment, we have removed impact calculations for adversely affected areas waterward of the hard armoring. While we acknowledge that shoreline armoring such as that proposed under the No Name Slough project will still cause adverse effects outside of its footprint, both in front of and behind the dike, those effects are not quantified using the calculator, but described qualitatively in the above analysis.

Determination of Habitat Service Value:

Before habitat service value:

We adjusted site conditions to likely provide little value to forage and cover through the metric large woody material (*ShorelStabiliz USZ install* tab F41-43). We believe that the before habitat service value of 0.6975[48] is appropriate: The toe or lowest riprap elevation is below MHHW (or OHW) that means the USZ 2 habitat value is somewhere in the shallow-subtidal range (USZ2 in the Nearshore Calculator). A habitat service value of 0.6975 is appropriate for this type of habitat with estuarine characteristics based on site conditions (some tidal channels visible in the vicinity, no LWM, no vegetation in ‘before’ conditions). A comparison with Blue Heron intertidal estuarine habitat service values listed below (NOAA 2007) confirms that the habitat service value determined with the Calculator is appropriate for the subject site:

shallow-subtidal distributary channel	0.75
shallow -subtidal open slough w/veg	0.9
low-intertidal distributary channel	0.6
shallow-subtidal distributary channel	0.75

48 The subject site habitat service value can be found on *NoEntryDSAYCalculations* Y321.

After habitat service value:

The after subject site habitat service value is based on the site conditions on the dike, *ShorelStab* tab C9-11, an upland area disconnected from the intertidal habitat by rip rap with half herbaceous cover and half unvegetated. The subject site habitat service value can be found on *NoEntryDSAYCalculations* Y322.

Adjustment Factors: Natal Estuary and Pocket Estuary selected in *ProjectD* tab.

Appendix 2.

Figure A2-1. Summary output for replacement of the shoreline armoring for the No Name Slough tidegate project.

FWS or NMFS #			
Project Name:	Padilla Bay Tide Gate		
Prepared on and by: (Add each update)	SIE & NR 4/18/2024		
Puget Sound Nearshore Habitat Conservation Calculator			
	Version 1.6		2/29/2024
This tool determines long-term habitat impacts and benefits for projects in the Salish Sea nearshore. Details about the use of this Conservation Calculator can be found in the User Guide, FAQs, and training materials, which are all available on the Puget Sound Nearshore Habitat Conservation Calculator Webpage			
		Conservation Credits/Debits	**DSAYs (Discounted Service Acre Years)**
Overwater Structures	Debit	0	**0.00**
	Credit (includes creosote removal)	8	**0.08**
	Balance	**8**	**0.08**
Shoreline Armoring	Debit	-423	**-4.23**
	Credit from Armor Removal	140	**1.40**
	Credit from Creosote Removal	0	**0.00**
	Balance	**-283**	**-2.83**
Maintenance Dredging	**Balance**	**0**	**0.00**
Boatramps, Jetties, Rubble	Debit	0	**0.00**
	Credit	0	**0.00**
	Balance	**0**	**0.00**
Riparian Enhancement/Degradation	**Balance**	**0**	**0.00**
SAV Planting	**Conservation Credit**	**0**	**0.00**
Habitat Loss / Remaining Conservation Offsets Needed		**-275**	**-2.75**

Summary | ProjectD | Overwater Structures | ShorelStab | Shorel Stabiliz USZ install | Shorel Stabiliz USZ remov

Appendix 3.

NMFS RPA Report

Project Name:

USACE Number:

NMFS Number: **WCRO-**

Report whether the action was taken on-site or off site, which type of action was taken, how much of each action was implemented, and corresponding conservation credits as listed in your final Nearshore Calculator or RPA verification letter. You may use the table below to report.

Enter RPA 1.1 and 1.2 Report if on-site or off-site	**Type of structure removed or action taken**	**Enter Metric in ft, sqft, cubic feet, or tons**	**Notes**	**Conservation Credits**
	Creosote removal			
	Bulkhead removal			
	Boat Ramp removal			
	Jetty removal			
	Overwater structure removal: pier		% grating	
	Overwater structure removal: ramp		% grating	
	Overwater structure removal: float		% grating	
	Removal of rubble			
	Addition of forage fish spawning gravel			
	Riparian plantings: native trees			
	Riparian plantings: native shrubs			
	Riparian plantings: native herbaceous			

Appendix 4. Response to Comments

Commenter	**Summary/Nature of Comment**	**Response to Comments**
	CONSULTATION HISTORY	
District	**Comment No. 8:** The consultation history is incomplete and inaccurate	The TFI Agreement programmatic consultation is separate from the present individual consultation, and has been reinitiated so is no longer in effect. However, in response to the applicant's comment, and in the interests of providing a more complete historical picture, we have revised the Opinion to include the history of the TFI Agreement consultation and the history of the No Name Slough tidegate project under the TFI regime.
	PROPOSED ACTION	
District (and USACE)	**Comment No. 1:** The Draft BiOp wrongly says it will occupy a slightly larger footprint but the existing footprint of the structure will not change. [USACE made similar comment] NMFS also fails to acknowledge that this riprap is replacing existing riprap at the site.	Based on the comments from the applicant and the Corps we have changed the description of the proposed action to remove statements that the proposed structures are larger than the existing structures. We have made changes to the effects analysis accordingly, including the Calculator input. These changes do not change our conclusions, but it does change the Calculator output and number of debits and thus the credits required in the RPA. NMFS acknowledges there is riprap at the project site and that some of it will be reused. We also understand that additional riprap will be added to the site while maintaining the size of the footprint. However, the proposed action rearranges, reworks, and adds material in a way that significantly extends the life of the shoreline armoring. For further details, please see NMFS's response below to the applicant's comments regarding baseline. For these reasons, NMFS considers impacts caused by the shoreline armoring to be effects of the proposed action.
USACE	The proposed project includes the complete removal of culvert #95, culvert #45 and the sheet pile cofferdam. A portion of the sheet pile cofferdam will not be left in place as stated in the BO. As the proposed action includes removal of the wooden box culvert, the effects from that removal need to be covered by the BO. The Corps therefore requests that NMFS remove the assertion on page four that NMFS is not considering any effects associated with removing the wooden box culvert.	In an email dated 4/16/2024 from Jenna Friebel (Consortium) to Kristin Murray (USACE), the diking district does not dispute the presence of the sheet pile planned for permanent placement. NMFS recognizes that the sheet pile does not add to the existing footprint, and does not, therefore, add to the project DSAYs incurred as a consequence of project effects. The sheet pile does not contribute to the debits calculated from the Nearshore Calculator. However, the permanent sheet pile piece left submerged and encased in the tidegate structure contributes to the extended life of the structure. Culvert #45 was partially removed after failing in 2019. NMFS has no record indicating that this work received a Corps permit or NMFS Section 7 consultation, including authorization under the TFI programmatic Opinion. Despite the confusing history of this project site, NMFS

Commenter	Summary/Nature of Comment	Response to Comments
		acknowledges that project site #45 is included in the project as a component of the proposed action. In our draft Opinion, NMFS did not include the work proposed at site #45 in our initial calculations of DSAYs debited to project effects. This is because we had conflicting information regarding the status of site #45 (i.e., was it completed under an emergency or not?). Now, NMFS understands that culvert #45 has been partially removed, filled with material, but there still remains work to be done and thus it should be included in the proposed action. We have incorporated work proposed at site #45 into the proposed action and analyzed the effects from that action. The addition of this work changed the calculator input and changed the output. The results did not change our conclusions. The project site will occupy the same footprint before and after construction.
	STATUS	
District	**Comment No. 9:** The Draft BiOp fails to properly account for the status of the relevant subpopulation. The Draft BiOp acknowledges that five Skagit River populations had productivity estimates above zero, but fails to account for this throughout the analysis. Ford 2022 recognized that its conclusions regarding recovery escapement levels and spawner-recruitment levels did not apply to the Skagit system populations.	We have added additional information about the status of these populations to make it more clear in the Status of the Species and Integration and Synthesis sections, and we have accounted for this throughout the analysis. The status of the Skagit populations is best summed up in the statement in our biological opinion "Despite the relative healthy abundance and diversity of the Skagit Basin Chinook populations in the ESU, they are at less than 20 percent of their overall recovery goal, and have experienced 15-year declining trends in abundance (Ford 2022)."
District	**Comment No. 12:** The climate change analysis is incomplete and inaccurate. NMFS relies on vague characterizations of forecasted impacts associated with climate change on habitat, most notably sea level rise and temperature The Draft BiOp omits any site-specific discussion of anticipated sea level rise ("SLR") even though this information is readily available on the	In response to the applicant's comment, we have added site-specific discussion of sea level rise to the Opinion. The applicant references certain climate change scenarios that represent downscaled projections of climate change, including sea level rise. NMFS included a broader-scale range of scenarios, but added new site-specific information. The additional sea level rise scenarios do not change our conclusions. Although most effects of future climate change on Puget Sound salmon are expected to be negative, these effects are not a key factor in reaching our jeopardy and adverse modification findings. Climate effects were only mentioned once in the species and critical habitat subsections of the Integration and Synthesis section "increasing sea surface temperatures are expected to negatively affect salmon population viability (Mauger et al. 2015)."

Commenter	Summary/Nature of Comment	Response to Comments
	University of Washington website. Review of this information (Figure 14) suggests that relative SLR forecasts for Padilla Bay are minimal over the next 50-years, and under some climate scenarios less than 0.0 ft. NMFS fails to consider larger contextual issues. With some of the richest, sub-irrigated alluvial soil on the planet and a conducive maritime climate, Skagit County farmland is uniquely positioned to continue producing food for regional markets.	The effects of the action, status of the species and critical habitat, environmental baseline and cumulative effects were much more important factors in reaching our conclusions. Given that most effects of future climate change are expected to be negative, considering additional information on how climate change is likely to affect PS Chinook salmon and SRKW would not change our conclusions. Contextual issues, including the use of surrounding land for agriculture production, are not relevant to our analysis of the effects of the proposed action on listed species and their critical habitat.
	ACTION AREA	
District	**Comment No. 4:** The action area is arbitrary and capricious. The Draft BiOp incorrectly identifies the action area as the entirety of Puget Sound. This designation is inconsistent with NMFS's regulations and prior biological opinions addressing projects in the nearshore environment, as well as its concurrences on other projects. *See*, e.g., Attach. 10–18. The action area must be identified by a scientific methodology, relevant facts, or rational connections linking the Proposed Action's potential impacts to the action area. The appropriate action area is defined in the BA	The action area is "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." To delineate the action area, we identify the geographic extent of all the various effect pathways and determine the outermost extent of all of these "zones of effect" ***combined***. For this consultation, the short-term construction-related effects all occur relatively close to the project site with noise having the largest zone of effect. However, there are enduring effects of the proposed structures on salmonid habitat that define the action area on the landward side of the tidegate structures. On the marineward side of the tidegate structure, the indirect, biological effects of the action on the prey base for SRKW define the outer edge of the action area. Specifically, the action area for this consultation includes the zone of effect where SRKW would have consumed PS Chinook salmon unavailable due to the proposed action. Best available science shows that Skagit River PS Chinook migrate out into Padilla Bay, among other pathways, and, after that, they travel and are available as prey for SRKW throughout the Puget Sound (Ford and Ellis 2006; Hanson et al. 2010; Chamberlin and Quinn 2014)). For this reason, the action area for the proposed action appropriately includes all of Puget Sound (as well as areas landward of the proposed tidegate structure). Therefore, we have not changed the action area though we have revised the Opinion to include a more detailed explanation of our scientific rationale. We note that the applicant cited its BA and nine prior NMFS biological opinions in support of a smaller action area. However, the BA did not address indirect, biological effects on SRKW and

Commenter	Summary/Nature of Comment	Response to Comments
		thus the action area described in the BA is, by definition, not correct. In addition, the nine biological opinions cited by the applicant in Comment 4 pre-date NMFS' more recent consultations which apply best available and evolving science to reach jeopardy/adverse modification conclusions for PS Chinook salmon based on impacts to nearshore PS Chinook habitat and, in turn, jeopardy/adverse modification conclusions for SRKW due to impacts on prey base. Thus, the action areas in the nine opinions cited by the applicant did not reflect impacts to the SRKW prey base and therefore are not relevant to the present consultation.
	ENVIRONMENTAL BASELINE	
District	**Comment No 1:** The baseline fails to account for the existing tidegate and riprap in the baseline, resulting in improper attribution of baseline conditions to the effects of the action. Given that riprap is hard rock with high strength and low erosive properties, the existing riprap at the site is not—as NMFS implies—near the end of its useful life. It is being removed to accommodate construction activities and then replaced. Any impacts or consequences to listed species and designated critical habitat that occurred due to the historical existence and operation of the existing tidegate structure are to be included in the environmental baseline The Draft BiOp attributes the prevention of restoration of the area behind the tidegates to the Proposed Action and analyzes and evaluates fish responses and other consequences of the Proposed Actions as if the existing tidegate, and historic and current impacts attributable to it, had never occurred. This approach is directly contrary to NMFS's approach in the TFI BiOp: NMFS states that "the effects of the proposed action assumes that	NMFS's draft Opinion did consider the site-specific effects of the historic and current existence and operation of the tidegates and associated dike structures on listed species and their critical habitat. We have added detail to the Environmental Baseline section to make this more clear. We have also added additional detail to clarify the historical condition of the estuary area affected by the project. We have also added information about fish use of No Name Slough to clarify. Nevertheless, in its draft Opinion, based on the materials it had and its analysis at the time, NMFS assumed there was no useful life remaining for the entire structure and factored that into its analysis. The submitted project package did not speak to the current condition of the dike, and any remaining useful life. Based on further review of the comments received and materials submitted by the District and the Corps, we have determined that there could be remaining life left in the armoring and so removal credit is reasonable. We note that the tidegates themselves appear to be failing and in need of immediate repair or replacement (based on the District's representations to the Court, their motion for a preliminary injunction, and the fact that one tidegate has already failed and has been partially removed and the area filled with material), and that removal of the surrounding riprap appears to be necessary to facilitate those repairs or replacement. Together this would suggest the old riprap has no remaining useful life because it is integrated and integral to the proper functioning of the new tidegate. That would weigh in favor of giving no credit for any remaining life. Nevertheless, for the reasons mentioned above, NMFS has changed its analysis and assumes in its final Opinion that the parts of the structure/riprap being replaced have 10 years of useful life remaining, and therefore acknowledged commensurate credit for removing the structure early/before the end of its useful life. This is now reflected in our analysis and we have updated the Nearshore Conservation Calculator output accordingly. Utilizing a rebuttable presumption that a structure has 10 years of life before it would need a repair to keep it in good working order is consistent with similar assumptions made in the Salish Sea Nearshore Programmatic Consultation (NMFS 2022c) and other similar consultations. *See*,

Commenter	Summary/Nature of Comment	Response to Comments
	regardless of the proposed action, the existing tidegate infrastructure will remain in place . . . On this basis, this analysis does not consider the prevention of full restoration of the area behind the tidegates to the condition that existed prior to construction of the diking and drainage system to be an effect of the proposed action."	*e.g.*, NMFS 2020, NMFS 2021, NMFS 2022b. As we already explained in the Opinion at Section 2.4.1, Distinguishing Baseline from Effects of the Action, we do not further consider the various, possible future degradation scenarios of the structure for the reasons articulated there. As acknowledged in the TFI Agreement, projects as extensive as the proposed action involving replacement of tidegates, and including those that require excavation of the tidegate and surrounding dike, extend the life of the facility. *See* TFI Section 4.1 which differentiates between minor repairs, major repairs (which shall not include actions that require excavation of the dike to accomplish the repair, and would in any event use no more than 10 cubic yards or less of new rock to restore the original footprint of rock armoring), and replacements (requiring excavation of the dike to provide access to the tube/tidegate, and done to "*extend the life of the gate facility or to restore impaired function*" (TFI at page 4-3, emphasis added). Here, the proposed action requires excavation and the addition of approximately 73.6 cubic yards of new rock material to facilitate the replacement (see description of action in the submitted BA; the numbers referenced in the November 18, 2022, email referenced in District Comment 1 apply to only one part of the project site). This proposed project prolongs the life of portions of the dike and associated tidegate, thereby preventing the recovery of habitat for a length of time commensurate with the new life of the structure. We assume the new structure will last 50 years based on our best professional judgment and other information, including our work with RGP-6/Structure in Marine Waters Programmatic (NMFS 2016c), as well as input from consultants that regularly assist applicants through permitting processes (Ehinger et al. 2023, Appendix E). Depending on design, engineering, and materials, useful life periods could also be shorter or longer. We acknowledge that the Swinnomish have asserted that the structure would instead be in place for the next 100 years. We also acknowledge that a dike and tidegates have been at this location and operating for over 100 years. BA at 2. However, for this consultation we applied a 50-year assumption. While we acknowledge that the structure may continue to exist and operate a longer period of time, we expect that it will require repairs to prolong its life within the next 50 years, consistent with our assumptions in other consultations as just described, and we expect that any additional life those repairs may cause, and their associated effects, will be evaluated at that time. Our conclusion that the proposed action will prolong the life of the structure is supported by the materials provided by the District. For example, excavation of the existing dike is necessary and

Commenter	Summary/Nature of Comment	Response to Comments
		will occur as needed to access the work areas and facilitate construction activities (BA at 10-12), indicating this is a replacement project; a new sheet pile piece will be permanently installed to prevent seepage under the structure (email from Jenna Friebel to Kristen Murray on April 16, 2024), stabilizing the structure; the project anticipates adding approximately 73.6 cubic yards of new rock material (BA; even if the number is less than 73.6, new dozens of cubic yards are proposed to be added); the dikes will be rebuilt and filled with clean clay; the dike will be regraded and strengthened using modern compacting requirements (engineering standards); and the tidegate will be made of materials including concrete and rebar. (e.g., BA at e.g., 3, 6, 9, 13-14). These significant actions will prolong the life of the replaced structures by, we are assuming, 50 years (beyond the 10 years of remaining life), thereby precluding the return of the affected area to functioning habitat by an equal amount of time. To the extent this approach is contrary to what was drafted in the 2009 TFI BiOp, that previous approach was not consistent with the requirements of the Endangered Species Act. Since 2009, NMFS and its federal partners have invested a significant amount of time, energy, and thought into better understanding their respective governing authorities and existing legal requirements. The current approach is what the law requires. *See*, *e.g.*, Memorandum Between the Department of the Army (Civil Works) and the National Oceanic and Atmospheric Administration, January 5, 2022.
USACE	The draft BO needs to include more project specific analysis to ensure the environmental baseline is appropriately capturing the existing condition that will continue regardless of Corps approval of the proposed action. The Corps requests NMFS, in coordination with the Corps, work through what level of perpetuating adverse effects are legally caused by the work being approved by the Corps.	Per your request, NMFS met with the Corps on April 16, 2024, to discuss the “level of perpetuating adverse effects … legally caused by the work being approved by the Corps.” In response to this comment by USACE and a similar one by the applicant, we amended the Opinion in several places, including updating the description of the proposed action and assuming a remaining useful life of ten years. Please also see the above response to the District’s comments regarding environmental baseline, which responds to the Corps’ comments regarding baseline vs. the effects of the action.
District	**Comment No. 6.** **Skagit watershed/Padilla Bay conditions are mischaracterized** Unlike most of the other Puget Sound watersheds, the Skagit watershed is largely undeveloped, with about half the Skagit Watershed total land area in	The applicant’s comment critiques the Environmental Baseline. Under the section 7 regulations, environmental baseline refers to “the condition of the listed species or its designated critical habitat *in the action area”* For the reasons described above, the action area is Puget Sound. Padilla Bay is only part of the action area and we describe Padilla Bay in the environmental baseline section. We made adjustments to this section where appropriate based on some of the specific information provided in your comments.

Commenter	Summary/Nature of Comment	Response to Comments
	public ownership, most of that managed by the National Park Service and U.S. Forest Service The Draft BiOP also inaccurately uses Skagit Bay and Padilla Bay somewhat interchangeably. …NMFS must focus its effects analysis on Padilla Bay, which is where the project is located. The Draft BiOp fails to consider the fact that the agricultural land uses in Padilla Bay, supported by the Proposed Action, have co-existed with generally healthy environmental conditions for well over a century. The references in the Draft BiOp to urban development or problems specifically associated with urban and suburban development should be struck as they are not representative of the land-uses supported by the Proposed Action or reflective of actual watershed characteristics of Padilla Bay. BO says "over 125 tidegates, pump house and floodgates currently regulate drainage within the Skagit estuary (Smith et al 2004). Few of these structures (i.e. Edison Slough, Brown Slough are design to allow fish passage, while the rest are drainage-only gates, providing fish passage opportunistically." This statement is based on outdated information and is misleading.	We also added information to the Integration and Synthesis section clarifying that the presence of high-quality habitat in the Upper Skagit Basin makes the Skagit populations of PS Chinook salmon important to conservation of the ESU as a whole. For additional responses to this comment, please see responses, including #3, below.
District	**Comment No 3:** There's no evidence of historical estuarine habitat (and therefore no future potential) NMFS has provided no site-specific technical information that would suggest that in the absence of the existing diking and drainage infrastructure an estuarine marsh suitable for and utilized by	We disagree with this comment and have added additional support in the biological opinion to clarify our finding that the proposed action precludes the development of estuary habitat behind the tidegate. We revised the BO and included the USGS maps from 1886, which indicates that marsh vegetation existed bayward of the tidegate and landward of the tidegate (see response below to Comment 16). We also added more recent sources indicating marsh habitat was common in

Commenter	Summary/Nature of Comment	Response to Comments
	juvenile Chinook rearing would exist at the site. Given that the land interior to the dikes and tidegates is subsided (well below the elevation of the fringe marsh), it is most likely that the area would simply become tidal mudflats. This conclusion is supported by the fact that the vast majority of Padilla Bay outside the existing dike is mudflats, and that historic maps of the project area do not indicate the presence of estuarine marsh habitat interior to the No Name Slough tidegates. NMFS provides no evidence to support its assertion as to the condition and/or the importance of historic nearshore habitat at the Proposed Action site for juvenile Chinook salmon rearing or that the area was historically used as critical habitat for Chinook. The extent of potential habitat is limited to a small blind tidal channel located nearly ten miles from the mouth of the North Fork of the Skagit River. In addition, blind tidal channels do not provide spawning habitat	Padilla Bay prior to human development. We add language that recognizes the mud flat immediately marineward of the armoring, but also point out the large eelgrass habitat in the low intertidal/subtidal areas. To the last point, the nearshore area at the project site was designated as critical habitat for the PS Chinook salmon in 2005. The designation process considered historic use, current condition, possible economic consequences of designation and other relevant factors. After weighing the benefits of designation against benefits of exclusion, NMFS designated the areas as critical habitat for PS Chinook salmon. See also our response to Comment No. 3.
District	**Comment No. 3 The Baseline is Inaccurate: The BO ignores lack of or limited existing fish access to Padilla Bay (McGlinn Jetty)** - the Draft BiOp fails to account for the effects of emergency repairs made to the McGlinn Jetty in 2023 that effectively prevent salmonids from entering the Swinomish Channel and migrating north to Padilla Bay where the Proposed Action site is located - Limited access to Padilla is further documented in SRSC estimates of the benefits to juvenile Chinook salmon from the Swinomish Channel Phase 3 Tidal	We disagree with the applicant's characterization of fish access to Padilla Bay and believe our Opinion accurately reflects best available science. The McGlinn jetty has existed for nearly 100 years and recent repairs made by the USACE were designed solely to protect fish and limit mortality at that site. Juvenile salmon that enter Padilla Bay from Skagit Bay swim around the jetty and have done so since its construction in the early 1900s. Recently, restoration concepts have developed with the USACE and breaching the McGlinn levee continues to be discussed as a viable option to increase the survival and improve the migration pathway for juvenile salmonids. However, the jetty does not currently prohibit juvenile salmon from entering and using Padilla Bay shorelines. SRSC mistakenly modeled Chinook salmon productivity as a *dike setback restoration project* instead of a *fill-removal restoration project* in the Swinomish Channel. The error thereby overestimated production of the restoration site. SRSC called out their error in a letter to WDFW.

Commenter	Summary/Nature of Comment	Response to Comments
	Marsh Restoration on the Swinomish Channel. Originally, SRSC characterized the benefit of this project to be 10,051 smolts/year but corrected this estimate to 73 smolts/year in. Attach. 9. It is clear that SRSC overestimated the abundance of fish in the Swinomish Channel and the likely importance of habitat restoration in the Swinomish Channel.	If the restoration site was, indeed, a dike setback site, the production of juvenile Chinook salmon would have remained 10,051 smolts per year. Thus, SRSC's model error does not overestimate the importance of habitat restoration in the Swinomish Channel or Padilla Bay. In fact, it reflects the value of dike setbacks as restoration projects and the juvenile Chinook salmon benefits of such actions. Juvenile PS Chinook salmon are known in Padilla Bay and the adjacent Swinomish Channel (Beamer et al. 2007; and Rice et al. 2011). In one study, Chinook salmon caught in Padilla Bay sampling efforts indicate that most juveniles originate from the Skagit River (Rhodes et al. 2006)
District	**Comment No. 5: The sources for existing conditions are incomplete:** - WDFW Salmon Scape does not map habitat for spring or summer Chinook, and only indicates that the Proposed Action site would be gradient accessible for fall Chinook. - WDFW Priority Habitat Database: NMFS omitted this data source - USGS National Map: This data source maps flow paths within the Proposed Action area and indicates that the lower portion of No Name Slough, immediately upstream of the tidegate, is artificial - Washington State Department of Ecology ("Ecology") WQ Assessment Tool: has not identified any water quality impairments in the vicinity of the project site or in Padilla Bay. - NOAA Critical Habitat Mapper: NMFS has omitted information from their own website. The NOAA critical habitat mapper does not depict critical habitat for any listed species landward of the No Name Slough tidegate - U.S. Fish & wildlife Service ("USFWS")	We disagree with the comment that our Opinion's sources for existing conditions are incomplete, and have made edits to the Opinion to improve clarity in relevant places. Salmonscape is not a complete platform that identifies all salmonids present or potentially present in all streams. Salmonscape is an interactive user interface that displays data from a WDFW database (Fishdist). Fishdist identifies streams that are known, presumed, or have potential to have salmonids present. Fishdist is co-managed, maintained and updated by tribes and WDFW. As new information becomes available the database is periodically updated. However, many waterways have yet to be identified as supporting or potentially supporting all salmonids. The lack of data about PS Chinook fry presence in No Name Slough does not mean that they aren't there or that they would not use the habitat behind the tidegate if the habitat were accessible. We have added clarity in the Opinion demonstrating use of Padilla Bay shorelines by juvenile Chinook salmon. Like Fishdist and Salmonscape, PHS data is not a complete dataset that identifies all species in all locations. For example, Chinook salmon are not identified as present on the west side of Orcas Island, which is well known for large schools of Chinook salmon. No Name Creek is a perennial stream and empties into No Name Slough. The channel is historically natural, but is now artificially modified by shoreline armoring, dikes, dredging, etc. Ecology and others have cited water quality impairments in No Name Slough. We reference these publications in our Opinion. NMFS acknowledged that critical habitat does not exist behind the tidegate in our Opinion.

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	Critical Habitat Mapper: NMFS has also omitted information from the USFWS website. USFWS does not map critical habitat for any listed species landward of the tidegate (Figure 8). - Historic GLO Maps: NMFS has also omitted information from the historic GLO maps of the website. These maps indicate the presence of the upper end of a small blind tidal channel and prairie interior to the tidegate. The old maps do not indicate any freshwater sources connected to the historic No Name Slough, nor do they indicate extensive areas of tidal marsh as suggested by NMFS in its analysis of impacts	The USFWS critical habitat mapper is also unnecessary because NMFS has already acknowledged that critical habitat does not exist behind the tidegate. Nevertheless, NMFS has accessed these platforms and has included them in the Opinion. NMFS cited several publications that used the GLO maps in its analysis of historical loss of estuarine habitat. The GLO maps are very coarse because they originate from very old surveys. This coarseness is evident when you consider that No Name Creek is a perennial stream that drains into No Name Slough, but does not show up on the old survey maps. The absence of No Name Creek in the GLO maps does not mean that the stream was formed since the surveys were conducted. Obviously, the stream was merely not included or missed during the large-scale surveys. Juvenile PS Chinook salmon are known in Padilla Bay and the adjacent Swinomish Channel (Beamer et al. 2007; and Rice et al. 2011). In one study, Chinook salmon caught in Padilla Bay sampling efforts indicate that most juveniles originate from the Skagit River (Rhodes et al. 2006)
District	**Comment No. 10 The Draft BiOp does not use the best available science regarding the importance of estuary habitat and the status of estuary habitat restoration.** - 2005 SCRP: "[t]he change in the tidal delta estuary footprint is useful for understanding broad changes to the delta landscape, but it does not represent the loss of specific delta estuary habitats directly used by juvenile Chinook salmon." - Also: "[e]ven with a 74.6% loss in the estuary footprint area, the loss in mapped open channel (distributary) area is only 30.4%, and the estimated loss in distributary edge habitat is only 20.7%." The estimates in lost blind tidal channel were made using regression and	Where appropriate and applicable we have added information to the BiOp based on your suggestions. Specific to the District's comments on the SCRP (2005), a recovery plan typically identifies limiting factors and threats. It does not determine which activities might cause jeopardy to a listed species. That determination is made in a biological opinion on a specific proposed action.

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	allometric methods and estimates that likely have high levels of error as later documented in Beamer et al 2016. *Id.* at 12. - NMFS has not addressed the complexities associated with the variety of Skagit Chinook sub-populations which have a variety of life history life histories, not all of which have estuary habitat as a limiting factor. - The Draft BiOp omits several relevant Skagit specific data sources that indicate that Skagit Chinook trends are independent of the amount of estuary habitat. E.g. WDFW Chinook Escapement Data for sub-populations of Chinook with estuary life histories between 1952 and 2004 indicate changes in trends in total escapement values over a long period of time (Figure 12). The changes in these escapement trends occur independent of the amount of estuary habitat, which have not changed significantly since the late 1800s. - Data from the WDFW Skagit River mainstem smolt trap near Mt Vernon, WA between 1993–2020, demonstrate notable trends in sub-yearly abundance - In addition, the Draft BiOp omits any discussion of the 2005 SCRP goals or the status of progress toward those goals, focusing solely on the Puget Sound Chinook Recovery Plan goals. - It is our understanding that the 2005 SCRP authors agreed that as of 2005, the Skagit watershed had already achieved	

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	50% of the Escapement Goal. - The 2005 SCRP also did not identify the persistence of diking and drainage infrastructure or associated agricultural land uses as jeopardizing the species. It is clear from the Draft BiOp that NMFS did not utilize updated information regarding the status of recovery in the Skagit prior to making regulatory determinations about the effects of the long-term persistence of diking and drainage infrastructure in Padilla Bay.	
	EFFECTS ANALYSIS	
District	**Comment 2:** NMFS erroneously relies on generalizations regarding the impacts of tidegates and shoreline armoring but provides no specific qualitative or quantitative analysis of the impacts of the Proposed Action.	NMFS has added additional localized information to our final Opinion. We used NMFS Nearshore Calculator to assess the effects of the proposed action on nearshore habitat (the marine side of the tidegate) at the project site and have clarified that quantitative analysis in the final Opinion. Specific to and nearby to the project location numerous studies and monitoring efforts have repeatedly documented the use of estuarine habitat by juvenile PS Chinook salmon in the Skagit delta after removal of dikes and levees (Greene et al. 2015). Restoration projects using dike setback, dike breach, or fill removal had juvenile Chinook densities within the restored channels consistent with unmanaged reference sites (Greene et al. 2015). Juvenile Chinook salmon are known in Padilla Bay and the adjacent Swinomish Channel (Beamer et al. 2007; and Rice et al. 2011). In one study, Chinook salmon caught in Padilla Bay sampling efforts indicate that most juveniles originate from the Skagit River (Rhodes et al. 2006). We have added additional information to the Opinion where appropriate to clarify our analysis.
District	**Comment No. 11:** The analysis of water quality impacts is not based on best available science. - it is unclear how NMFS concluded that water quality impairments in the interior reach of No Name Slough are an impact to salmon when NMFS has not identified this area as critical habitat and has cited in other sections of the Draft BiOp that the tidegate blocks access to this habitat.	NMFS makes clear reference to the tidegate opening (on average) twice per day. The degraded water quality behind the tidegate is thereby released into Padilla Bay subjecting any juvenile PS Chinook salmon and PS Chinook critical habitat to these degraded water conditions. The water behind the tidegate need not be designated as critical habitat in order to affect PS Chinook salmon. Degraded water quality has been detected in Padilla Bay (though not the sediments). Juvenile salmon are susceptible to the exposure of degraded water quality in ways that harm them as we describe in the Opinion. Our Opinion lists specific water quality impairments for which No Name Slough is listed on the 303(d) list.

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	- The Draft BiOp states that "[n]early all freshwater emptying into Padilla Bay is from agricultural watercourses, including No Name Slough." Padilla Bay is approximately 11,000 acres and contains nearly 8,000 acres of eelgrass, which provides a rich community of nursery habitat for salmon, crab, perch, flatfish and herring - Agricultural land-uses, and the diking and drainage systems that support them have been present in the Padilla Bay watershed since the late 1800s. There is no evidence that the agricultural land-uses, and the diking and drainage systems have had a significant and negative impact on Padilla Bay	NMFS acknowledges that Padilla Bay can provide good habitat for rearing juvenile salmonids and that Padilla Bay is part of the action area for this consultation. Our analysis also shows how the proposed action degrades the quality of nearshore habitat and precludes development of estuary habitat behind the tidegate. The Opinion also identifies water quality impairments in No Name Slough, indicating not all freshwater entering Padilla Bay is of high quality. For example, The Washington State Department of Ecology has extensive data showing bacterial contamination in Padilla Bay. The contamination is affecting beneficial uses in the area, such as shellfish harvesting and recreation. Several water bodies in eastern Padilla Bay and its watershed are included on Ecology's 303(d) list of impaired waters. On the list of impaired waters are parts of Padilla Bay, Joe Leary Slough, No Name Slough, Indian Slough, and Big Indian Slough. Additional water quality parameters of concern in the sloughs include DO, pH, and temperature (Washington Department of Ecology. 2016. Quality Assurance Project Plan Eastern Padilla Bay Tributaries Fecal Coliform Bacteria Total Maximum Daily Load. Publication No. 16-03-105.) The environmental baseline of the Opinion describes in detail how estuary and nearshore habitat throughout Puget Sound has been degraded by human development. Our analysis details how the proposed action causes loss of nearshore habitat quality in front of the tidegate and precludes development of estuary habitat behind it. The fact there is high quality habitat nearby does not change our assessment of the proposed action. At first glance, one might conclude that if nearshore or estuary habitat quality were high at a particular project site, this could lead to a finding that the particular project would not diminish the value of that habitat for PS Chinook salmon, PS Chinook critical habitat, or SRKWs. The basis of this analysis would be that any high-quality habitat at a project site would be able to absorb the impact of the adverse effects caused by the proposed action. Or, stated differently, a relatively small increment of adverse effect on high quality salmonid and critical habitat is not as detrimental as the same increment of adverse effect on impaired habitat. However, this approach is inconsistent with the evaluation required by ESA section 7. When completing our analysis, we 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, determine if the proposed action is likely to jeopardize the continued existence of a species or adversely modify critical habitat. The overall status of nearshore and estuary habitat for PS Chinook salmon, PS Chinook critical habitat, and SRKWs is poor and continuing to decline. As noted previously, the loss of this habitat quality is a factor for decline for PS Chinook salmon. Given the negative trend in the quality of nearshore habitat for PS Chinook salmon, PS Chinook critical

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		habitat, and the risk that poses for SRWKs, protection of currently high-functioning habitat is critically important. The need to protect quality habitat is expressed in the recovery plan for PS Chinook salmon (SSPS 2005). Our biological opinion explains why protecting the Skagit populations is important to the survival and recovery of the ESU as a whole.
Swinomish	One notable omission in the BiOp that should be addressed is the predator trap that tidegates create for juvenile salmon	The Swinomish letter did not provide any scientific support for the "predator trap" effect on salmon. Rillihan et al. 2021 found tidegates could affect predator prey relationships between striped bass and herring and Wright et al 2014 suggested migration delays at tidegates could increase predation on brown trout (*Salmon trutta*); however, we did not find any evidence that tidegates increase predation of salmon in Puget Sound. There is some indication that other types of structures such as dams and bridges can increase predation on salmonids. Including this additional impact in our analysis of effects of the action would not change our conclusions in this consultation.
Swinomish	Best science by NOAA Fisheries and SRSC has clearly shown that self-regulating tidegates are not any better for salmon recovery than standard tidegates. We believe that there should be no "credit" given to the project proponent for use of a SRT in the proposed action because the notion that SRTs are "fish friendly" is a fiction.	NMFS analyzed the action as proposed. We applied the NHVM Calculator to assess the effects of the proposed action on the quality of nearshore habitat and other best available and qualitative approaches to assess the remaining effects. No "credit" was applied based on the type of tidegate proposed.

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District	**Comment No. 13:** Reliance on the Salish Sea Nearshore Programmatic Biological Opinion is improper. NMFS has previously concluded that the SSNP BiOp does not apply to tidegate projects. Furthermore, NMFS's approach to analysis of impacts associated with programmatic actions is entirely inappropriate in the context of a project-specific consultation.	NMFS's references to the Salish Sea Programmatic Opinion were and are appropriate. The references explain an existing, voluntary program that is part of the Environmental Baseline. The Opinion is also appropriately referenced to indicate consistency in our conceptual approach (including assumptions made) when analyzing existing structures affecting the Puget Sound nearshore. It is also relevant for explaining how numerous other applicants have successfully met the requirement to offset in full the enduring effects of their projects. As of April 16, 2024, approximately 193 projects have been approved under the Program. NMFS disagrees that the Conservation Calculator cannot be used to evaluate the effects of a tidegate project. In this case, NMFS modified the calculator parameters to account for the unique setting and nature of this project, and appropriately used it to quantify the effects caused by the footprint of the project. NMFS used the Nearshore Habitat Values Model that underlies the Calculator to quantify the physical and biological features relevant for the subject habitat. That model provided the habitat service values for the Habit Equivalency Analysis. NMFS compared the resulting habitat service values for the subject estuarine habitat with habitat service values for the Blue Heron estuarine restoration project to confirm that they were appropriate. Other effects of the project on the surrounding environment are evaluated using other methods, including a qualitative analysis, and a best available evaluation of acres of habitat affected behind the tidegate.
	INTEGRATION & SYNTHESIS/CONCLUSION	
District	**Comment No. 14:** The Preliminary Jeopardy Conclusion is Flawed NMFS improperly relies on baseline conditions to support its jeopardy conclusion. NMFS fails to identify the magnitude and significance of the effects that are actually caused by the Proposed Action. NMFS then compounds these errors by relying on various recovery plans to support and justify its conclusions. Draft BiOp at 108–10. It is	We have considered all the comments, analysis, and information provided by the commenters (including the applicant) in our final Opinion. Where appropriate, we have revised and updated the Opinion and provided responses in this appendix to address those comments. Correspondingly, we have revised and updated our integration and synthesis and overall conclusion as well. As noted above, the environmental baseline is appropriately described in our biological opinion. We made some adjustments to this section based on the applicant's comments. The condition of the environmental baseline is only one factor in our analysis. We added the effects of the

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	well established that the ESA does not mandate compliance with recovery plans and that recovery plans do not create any legal rights or obligations.	proposed action to the environmental baseline and cumulative effects and also considered the status of the species and critical habitat and climate change to reach our conclusions. Recovery plans are non-binding documents that in and of themselves, do not create any regulatory requirement. However, these plans contain important scientific information about the subject species, particularly in regards to limiting factors, delisting goals, and actions recommended to help recover species. This information is part of the best available scientific and commercial data we consider during consultation.
District	**Comment No. 15:** The Preliminary Adverse Modification Conclusion is Flawed The ultimate determination applies to the value of the critical habitat designation as a whole. The Draft BiOp flips this analysis on its head: ignoring the minimal impact that the Proposed Action will have in the vicinity of the Proposed Action, and presuming (without support) effects to all of Puget Sound. Given the disparity between the vast extent of designated critical habitat and the small, localized footprint of the Proposed Action, NMFS fails to explain how the Proposed Action along with any purported consequences to critical habitat will result in any diminishment of the value of the entirety of the designations.	As described earlier, the appropriate action area for this consultation is Puget Sound. We did scale up our analysis of impacts in the action area to the critical habitat designation level in order to reach our conclusions. We have made some edits to the Integration and Synthesis section of the Opinion to make this more clear.
District	**Comment No. 7:** The Draft BiOp is inconsistent with NMFS's prior TFI decisions.	The applicant states that NMFS agreed in 2019 that the proposed action qualified as an Operational Improvement Project under the TFI Agreement process; determined that no credits were therefore necessary because such projects benefit the environment; and, determined that the proposed action was covered by the no jeopardy opinion on the TFI Agreement. The applicant alleges the current Opinion and RPA are inconsistent with these decisions. The applicant says that NMFS recommended reinitiation of the TFI biop due to progress toward restoration goals not concern about interpretation of Operational Improvement Projects. NMFS has considered these comments and does not believe any changes to the Opinion or RPA are warranted as a result. Our reasoning is as follows:

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		● The current Opinion is the result of an individual consultation, in response to the applicant's request for consultation on its specific proposed action. Programmatic opinions differ from individual consultations because they analyze the aggregate effects of a broad suite of actions, including beneficial actions. ● In addition, as the applicant acknowledges, the biological opinion on the TFI Agreement is no longer in place. NMFS' conclusion that the TFI biological opinion should be reinitiated was in part due to the interpretation and application of elements of the TFI program (including Operational Improvement Projects (OIPs)), because this was influencing the slow pace toward restoration goals. Our reinitiation letter reflects this in the following statement: "As you may be aware, issues related to the *interpretation and application of elements of the TFI implementing agreement* have arisen over time, which NMFS is concerned may result in effects to the listed species and their habitat in a manner or to an extent not previously considered." Specifically, as projects were increasingly interpreted as OIPs, the restoration credits associated with those tidegate complexes and anticipated by the TFI Agreement and its biological opinion were not materializing. ● In any event, the TFI biological opinion was written in 2009 and best available science regarding effects on species and critical habitat - as well as understandings of the correct interpretation of the ESA relative to certain structures - have evolved since then (see response to comments regarding environmental baseline) so it is not appropriate to rely on the opinion from 15 years ago. Finally, comment no. 7 appears to suggest that the proposed action should be treated as having positive benefits on ESA species and habitats because the tidegate/pipes will have lesser impacts than the ones it would replace. The correct approach under the ESA is to analyze the effects of the action as proposed – rather than its comparative benefits – and that is what our Opinion does.
	REASONABLE AND PRUDENT ALTERNATIVE	
District	**Comments1 and 16:** Conservation debits/credits were miscalculated Because the riprap is simply being replaced, and the footprint is not expanding, District 12 is entitled to credit under the conservation	The submitted project package did not speak to the current condition of the dike. Based on Comments received from the District and the USACE, including photos as well as representations of the current state of the riprap, we have revised the effects analysis and the RPA. Please see the responses to comments above for details on how we are addressing and evaluating the existing riprap.

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	calculation.	
Swinomish	It is highly questionable why NMFS chose a 50-year lifespan here, because the type of structure being proposed would almost certainly last much longer than 50 years -- it is a large concrete structure filled with rebar.	Please see NMFS's response to the District's comments on Baseline for a response to this comment. We have also added additional explanations into the Opinion, as appropriate, to clarify. Further, a review of available information highlights multiple references and examples supporting the use of 50 years as an approximate range for the useful life of these structures before requiring repair or replacement, i.e., Massachusetts Water Resources Authority, Winter Lake Project, Oregon, Palo Alto Tide Gate, Duck Bill Tide Gate, Oregon Coast.
Swinomish	We appreciate that NMFS has chosen to utilize both the prior TFI habitat credit acreage as well as the Calculator, we believe it is necessary for NMFS to explain whether and to what extent the 350 habitat credits estimated from the Calculator account for known but currently unmeasured effects.	Our Calculator analysis quantifies habitat impacts for the "rectangle" of habitat impact that is occupied by the area of the dike (including the tidegates) that is being replaced. The overall footprint is calculated as being 85 feet long and 66 feet wide (5610 square feet or 0.129 acres total). We have assumed the structure had 10 years of remaining life , and assume the structure will have impacts for the next 50 years. Please see responses above and Appendix 1 and the Excel Nearshore Calculator for additional details on this calculation.
Swinomish	What is the confidence interval that NMFS utilized in arriving at the 350 habitat credits? Put differently, what is NMFS's confidence level that the 350 habitat credit requirement is 95% likely to fully mitigate the adverse impacts of the proposed action for the full life of its impact? There should be a "margin of error" factor applied to the proposed action to increase the required number of habitat credits to ensure that the final mitigation package has a high probability (95%) of mitigating the adverse impacts to ESA-listed species.	NMFS's Nearshore Calculator was recently peer reviewed by an independent expert panel who found that the Nearshore Calculator is based on best available science and generates reasonable and well-supported outputs. *See*: https://www.fisheries.noaa.gov/west-coast/habitat-conservation/independent-peer-review-noaa-fisheries-puget-sound-nearshore. NMFS continues to improve the Calculator as science evolves. At this time, it is the best tool available for quantifying impacts of structures in this kind of environment. We note that we do provide a qualitative error analysis in Ehinger et al. 2023. For additional details on what assumptions were made for this particular calculation, please see the above answers and reference Appendix 1 and the Excel Nearshore Calculator attached to the Opinion. Effects of the proposed action that were not quantified by the calculator were analyzed qualitatively or otherwise in the Effects section of the BO.
Swinomish	How did NMFS address the lack of a Beachslope Reference Line in calculating the habitat credits required via the Calculator? There is no Beachslope Reference Line for No Name Slough. As a result, NMFS's current Calculator almost	In a traditional marine nearshore environment, NMFS's nearshore calculator utilizes beach slopes and HAT reference lines. However, because this project is located in an estuary where the concept of a typical beach slope (as documented in Cereghino et al. 2023) doesn't apply, we used a modified Calculator approach in combination with habitat values developed for the Blue Heron Estuary Restoration HEA. We used the Calculator to quantify the effects of extending the

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	certainly underestimated the cumulative and individual direct and indirect impacts to habitat behind the tidegate. We request that NMFS show how it arrived at the 350 habitat credits without a Beachsope Reference Line at No Name Slough.	conversion of intertidal habitat to dike habitat for 50 years due to the replacement of hard armoring. We limited the affected area to the footprint of the repaired/replaced dike structure (including tidegate), a "rectangle" of habitat impact that is 85 feet long and 66 feet wide (5610 square feet or 0.129 acres total) lasting for 50 years. *See also* above answers. We compared habitat service values determined using the Nearshore Calculator with habitat service values developed for Blue Heron and found them to be in range and comparable. The Project D tab of the project calculator describes how the structure was entered. Effects of the project that were not quantified by the Calculator were analyzed qualitatively or otherwise in the Effects section of the BO. Even though the Nearshore Calculator was not able to quantify all effects of the proposed actiont, we analyzed all effects and took them all into account in our analysis. We disagree that this Calculator limitation undermines our RPA. "A 'reasonable and prudent alternative' is a flexible standard for the consulting agency; it is not the equivalent of the 'least restrictive alternative.'... [T]he consulting agency is 'not required to explain why he chose one RPA over another,' nor is it 'required to pick the best alternative or the one that would most effectively protect the species from jeopardy.' Rather, the [Service] 'need only have adopted a final RPA which complied with the jeopardy standard and which could be implemented by the agency.'" *San Luis & Delta-Mendota Water Authority v. Jewell*, 747 F.3d 581, 624 (9th Cir. 2014) (quoting *Sw. Ctr. for Biological Diversity v. Bureau of Reclamation*, 143 F.3d 515, 523 (9th Cir. 1998).
Swinomish	"Given time constraints, we were not able to conduct the literature search that would be necessary in order to adjust the Calculator to take into account adverse impacts specific to areas waterward of a dike. Thus, different from in shoreline habitats, we removed a 20 wide adversely affected area waterward of the hard armoring." Can NMFS please explain how this impacted the habitat debits they generated in the Calculator? Did NMFS just omit this from its quantitative analysis via the Calculator?	Although we determined that the area in front of the hard armouring should not be included in the Calculator inputs due to the absence of typical beach environment and associated wave action (which the current Calculator assumes), we took other steps to ensure the output reliably and accurately reflects the effects of the structure on the nearshore using best available quantification methods. In particular, as mentioned, we used a modified Calculator approach (see Appendix D) and compared habitat service values with those developed for the Blue Heron estuary and found them to be in range and comparable. In addition, local scour effects waterward of shoreline armoring on sediments are linked to reduced epibenthic prey production immediately water-ward of hard armoring in both nearshore (Dugan et al. 2008) and estuarine environments (Morley et al. 2012; Munsch et al. 2017; Sobocinski et al. 2010; Toft et al. 2010), and these effects are qualitatively taken into account in NMFS' effects analysis. Also, see previous responses.

Commenter	Summary/Nature of Comment	Response to Comments
Swinomish	Draft BiOp states that, "We are not considering sea level rise for this assessment as this assessment quantifies the footprint of the armoring only. This assessment does not quantify impacts landward of the shoreline armoring (see Dike and Drainage Maintenance in Section 2.9). Sea level rise would not affect the footprint of the armoring." The Tribe believes this is short-sighted for at least two reasons. First, there is a wealth of current science that indicates coastal flooding, sea level rise, and king tides are and will continue to impact shorelines throughout Puget Sound. Given the probability that repairs and maintenance to the No Name Slough tidegate and associated infrastructure would likely be required, the Draft BiOp does not, but must, account for the applicant's future need to maintain and increase the level of shoreline protection and armor around this infrastructure over the next 50-100 years of useful life.	As explained above and in the Opinion, we used the Calculator to quantify certain effects of extending the conversion of intertidal habitat to dike habitat for 50 years based on the footprint of the proposed repaired/replaced hard armoring (including the tidegate). Consideration of sea level rise would not affect this part of the Calculator analysis as the relevant input parameters are the duration of impact, footprint of impact and habitat service values. None of these input parameters would be affected significantly by sea level rise. Sea level rise is considered elsewhere in the effects analysis.
District	**Comment No. 16:** Some aspects of the RPA are not technologically feasible	The District makes a range of arguments regarding the technological feasibility of the RPA. We have carefully considered these arguments and provide our responses below. **Credits-Option 1: On-site Habitat Improvements** **Comment:** District 12 has a narrow easement of 30 feet from the toe of the existing dike. There are no overwater, derelict structures on-site. Therefore, it is infeasible to make on-site improvements. **Response:** We have revised the final Opinion to clarify that "on-site" habitat improvements was intended to refer to improvement projects anywhere within the applicant's discretion and control**.** Thus, this Option is not limited to the proposed project's 30-foot easement. **Comment:** District 12 could remove the additional creosote pilings, but this would only create 7.5 credits, leaving it well short of the RPA requirement. **Response:** As above, the applicant is not limited to removing piles within their easement. In addition, the applicant can satisfy the Credits part of the RPA through a combination of any of the five options.

Commenter	Summary/Nature of Comment	Response to Comments
		Comment: District 12 cannot remove shoreline (dike armoring) because the dike needs protection from coastal waves and erosion processes. **Response:** NMFS suggested shoreline armouring removal as an example of habitat improvement *outside* the applicant's discretion and control under Option 2 so District 12's inability to remove its own dike armoring does not undermine the feasibility of this option (see below for explanation as to its feasibility). **Comment:** The area outside of the tidegate structure is extensive mudflats so it is unlikely that District 12 could establish either submerged or shoreline planting within their easement. **Response:** As above, under Credits-Option 1, the applicant is not limited to planting within the proposed project's easement. Also, planting was just one example NMFS suggested. There are others both within this Option and within other Options. According to the WADNR eelgrass survey mapper, eelgrass is prevalent in Padilla bay at depths +5.83 MLLW and deeper suggesting feasibility of planting under Credits-Option 2. **<u>Credits - Option 2: Off-site Habitat Improvements</u>** **Comment:** Removing overwater structures is infeasible because District 12 is not aware of any overwater structures off-site that are no longer in use and could be acquired and removed. NMFS has not identified any such site, and even if such a site could be identified, District 12 lacks control over whether the owner would sell the property. It is also unclear how many treated piles are in Padilla Bay and the District would need to remove and dispose of an estimated 234 piles to generate 350 credits. **Response:** The applicant wrongly assumes that Option 2 habitat improvements can only occur in Padilla Bay. Our RPA general condition in the draft Opinion was broader, stating that projects must be in Padilla Bay or Skagit Bay. We have clarified this in the description of RPA Credits-Option 2. Also, with regard to pile removal, the applicant can satisfy the Credits part of the RPA through a combination of any of the five options so it would not need to find 234 piles to remove. In addition, regarding landowner permission or willingness to sell, County Assessor records indicate that some land on the marine side of the proposed project is owned by the Washington State Department of Ecology, which has a statutory mission compatible with restoration. **Comment:** District 12 cannot remove shoreline (dike armoring) because the dike needs protection from coastal waves and erosion processes. **Response:** Because Credits-Option 2 applies to habitat improvements outside the applicant's discretion and control, District 12's inability to remove its own dike armoring does not undermine the feasibility of this option.

Commenter	Summary/Nature of Comment	Response to Comments
		<u>**Credits-Option 3: Restoration Funding**</u> **Comment:** This option of the RPA is unlikely to achieve its intended purpose (for various reasons). **Response:** The reasons provided by the applicant pertain to restoration of *estuarine habitat on the landward side of the tidegates* (i.e. Acres–Option 1, rather than Credits-Option 3) so we have addressed this comment below under that heading. <u>**Credits-Option 4: Conservation Credit Purchase**</u> **Comment:** Based on recent experiences on a different repair project that also required conservation credits, FEMA determined that the PSP bank was not a valid mitigation bank and, therefore, FEMA informed that district that the purchase of PSP conservation credits was not a viable option for ESA compliance. Prior to determining if this option is feasible, District 12 requests that either NMFS or the Corps audit the PSP and determine if they are a valid mitigation bank. **Response:** NMFS, FWS and PSP are parties to a Memorandum of Understanding which governs the PSP conservation crediting administration in Puget Sound nearshore. Under the MOU, the Services verify credit calculations for all conservation projects to be funded through PSP before PSP funds the projects. The Services also assess the valuation of credits and debits to ensure the conservation values offset the impacts as analyzed in relevant Biological Opinions. Based on these, and other assurances contained in the MOU, NMFS considers PSP to be a valid conservation credit bank. We do not know why FEMA may have taken a different position but note that FEMA operates under different authorities than NMFS. We also note that the PSP credit model is working successfully in the context of NMFS' batched opinions on Puget Sound nearshore projects and the SSNP programmatic consultation. **Acres: Estuarine habitat restoration** **Comment:** NMFS does not accurately understand current hurdles for implementation of large-scale estuary habitat restoration projects, including the cost, effort, and partnerships involved in meaningful habitat restoration projects; many of the remaining estuary restoration projects identified in the 2005 SCRP projects are located on private land and land acquisition is a major hurdle; the remainder of the 2005 SCRP projects require setback of significant diking and drainage infrastructure, which requires authorization and buy-in from other Skagit diking and drainage special purpose districts; restoration sponsors existing in the Skagit delta, including the Skagit River Systems Cooperative, the Skagit Conservation District, the Skagit Fisheries Enhancement Group, and the Nature Conservancy have not been successful and the SRSC may have a conflict of interest.

Commenter	Summary/Nature of Comment	Response to Comments
		Response: - As an initial matter, we note that restoring acres is only one option for achieving the Acres portion of the RPA, the other being contributing funding toward such a restoration. To underline the feasibility of the funding option, we have revised the Opinion to note that one option may be to enter into a revolving restoration agreement with a sponsor, whereby the applicant reimburses the sponsor for completed restoration work, and the funding provided will be used for a future project. With regard to implementing restoration projects, we note that NMFS is integrally involved in such projects so has a clear understanding of what's involved. In addition, the applicant is not limited to projects identified in the 2005 SCRP as the comment assumes. The applicant can use its own land for restoration projects or can partner with public landowners. We disagree that existing restoration sponsors have been unsuccessful. The Skagit River System Cooperative (SRSC) has completed many estuarine and nearshore restoration projects in the Skagit delta. The Tribes that make up the SRSC (Swinomish and Sauk-Suiattle) have reservations in the Skagit Basin, and treaty rights to fish in their Usual and Accustomed fishing areas. The applicant is not obligated to work with SRSC and, as a Trustee, NMFS observes that the tribes may have a strong interest in habitat restoration, and not a conflict of interest. Restoration is commonly a partnership among several restoration practitioners. The Nature Conservancy has completed numerous large-scale estuarine restoration projects, including Port Susan Bay Preserve, and partnered with NOAA and the SRSC to complete the Fisher Slough restoration project in the Skagit Delta. The Nature Conservancy is actively engaged in restorating habitat for juvenile salmon behind tidegates (see https://www.nature.org/en-us/about-us/where-we-work/united-states/oregon/stories-in-oregon/what-is-a-tide-gate/).
District	**Comment No. 16:** NMFS fails to provide any economic analysis to support its feasibility	The ESA nor its regulations or any applicable case law, support the notion that NMFS is required to provide an economic analysis to demonstrate feasibility of an RPA. To the contrary, NMFS is not required to "account for the cost" of the RPA (*San Luis & Delta-Mendota Water Authority v. Jewell*, 747 F.3d 581 (9th Cir. 2014)) and is only required to provide "some analysis" of the RPA it selects. *DOW v NMFS*, 2013 WL 632857 (C.A.4 (Md.) citing *Greenpeace v. Nat'l Marine Fisheries Serv.*, 55 F.Supp.2d 1248, 1268–69 (W.D.Wash.1999). Notwithstanding, NMFS has gone to some lengths to examine the economic feasibility of the range of RPA options it has provided, including researching the general availability of restoration opportunities, the costs of past restoration projects, the cost of conservation credits, land ownership adjacent to the proposed project site, as well as the financial status and landholdings of the applicant. We have revised Opinion to reflect the analysis we have done in order to conclude that the RPA is economically feasible. *See also the next* response.

Commenter	Summary/Nature of Comment	Response to Comments
District	**Comment No. 16: The RPA is not economically feasible**	Overall Comment: District 12 has a drainage operating budget of $100,000 per year so many (if not all) of the RPA options are economically infeasible. Response: The ESA requires only that an RPA "can be taken by the Federal agency or applicant." 35 USC 1536(b)(3)(A)(emphasis added). Accordingly, NMFS need only "consider whether its proposed alternative is financially and technologically possible," and is "not responsible for balancing the life of the [endangered species] against the impact of [the RPA]." (San Luis & Delta-Mendota Water Authority v. Jewell, 747 F.3d 581 (9th Cir. 2014)). NMFS is also not required to "pick the best option for the industry." DOW v NMFS, 2013 WL 632857 (C.A.4 (Md.) citing Greenpeace v. Nat'l Marine Fisheries Serv., 55 F.Supp.2d 1248, 1268–69 (W.D.Wash.1999). Nevertheless, it appears in this case that the RPA options NMFS has provided are economically "possible" for the applicant. Although the applicant's comments state an annual 'drainage' operating budget of $100,000 per year, the applicant is the"Skagit County Dike, Drainage and Irrigation Improvement District 12" and the balance sheet for that entity on the Skagit County Assessor's records show a total of $19,066,157 in cash and investments (Audit report published October 2023) https://portal.sao.wa.gov/ReportSearch/Home/ViewReportFile?arn=1033364&isFinding=false&sp=false The applicant does not explain the relevance of its drainage budget (versus its annual diking budget of >$2.5 million) in relation to the proposed action. In any event, we note that diking and drainage districts have the authority and ability to collect levies/assessments (RCW 85.18.010; RCW 85.06) and that District 12's drainage and diking assessment areas both include No Name Slough, indicating the applicant's ability to raise funds as needed for project costs https://www.skagitcounty.net/departments/gis/gallery/main.htm#dike In addition, the Skagit County website shows that "Dike District No 12" owns 100+ parcels of land, totaling more than 270 acres https://www.skagitcounty.net/Search/Property/ If it is Skagit County Dike, Drainage and Irrigation Improvement District 12 (i.e. the applicant) which owns this land it could provide cost-effective opportunities for implementing the RPA. Some parcels are within the non-tidal delta area identified in the Chinook Recovery Plan as having potential for restoration -- see Figure 10.2(B) and pages 118-128. Assessor records also indicate that all of the land on the landward side of the proposed project is owned by the Washington State Department of Fish and Wildlife or the Department of Ecology as are large areas marineward of the proposed project. Given the statutory missions of these agencies, this land ownership would suggest that RPA Credits-Option 5 (modifying the project to

Commenter	Summary/Nature of Comment	Response to Comments
		setback the shoreline armoring) and/or Credits-Option 2 (off-site habitat modification) are not only technologically feasible but would also be economically feasible given that market land prices would likely not be required. The Assessor website also shows that privately held land inland from No Name Slough has a market value of about $7,000 per acre, such that 8.6 acres would cost approximately $60,000. In addition, although the applicant cites to one (Fisher Island) estuarine restoration project to predict a $2.5 million cost for RPA restoration, that prediction is not supported by a more comprehensive view of restoration project costs. As indicated above, there are options for restoring land already owned by the applicant. In addition, both nearshore habitat and estuarine restoration projects vary greatly in cost. The Fisher Slough restoration project included dike setback and tidegate relocation efforts. Restoration projects that involve dike breaching instead of setbacks can cost considerably less. For example, an estuary restoration project in the Snohomish estuary (Mid-Spencer) restored 74 acres of juvenile Chinook salmon habitat by lowering and notching dikes to restore flow to the estuary. The cost of design and construction was $1.3M, or $17,600 per acre (2019 dollars). The Pierce Conservation District has proposed to complete a shoreline armor removal project on Henderson Bay in Pierce County. The project includes design, permitting and implementation and will benefit forage fish and juvenile salmonid in the nearshore. Removal of up to 700 feet of armor will restore natural shoreline sediment processes and contribute sediment to the beach. This will also reconnect existing mature marine riparian vegetation, providing shade and organic debris to the nearshore. The cost of this effort is $560,204. Lastly, we note two anomalies in applicant's "Total Estimated Cost of RPAs" (Table 7). First, the applicant erroneously includes the cost of Reasonable and Prudent Measure (RPM) 3a. RPM3a is part of the Incidental Take Statement, not part of the RPA so cannot be considered part of its cost. Moreover, the RPM3a is actually part of the proposed action and so, on reflection, NMFS has decided there is no need to repeat it as a RPM and so has deleted it in the final ITS. Second, Table 7 suggests that the project cost is $100,000, implying that the cost of restoration is out of step with the cost of the project. However, in Comment 7, applicant concedes that projects such as the one proposed "cost well over $1,000,000."
District	**Comment No. 16:** The District should be allowed to use TFI credits toward any RPA.	Refer to NMFS' response to Comment No. 7. The TFI credits were generated and recognized in the context of a program which was analyzed in NMFS' TFI programmatic biological opinion. The ESA coverage for the TFI program was ultimately determined not to be valid and hence the

Commenter	Summary/Nature of Comment	Response to Comments
		biological opinion reinitiated and the program suspended. Thus, the TFI credits cannot be relied upon in this individual consultation.
USACE	The Corps questioned whether NMFS intended to require creation of estuarine habitat from upland habitat.	The intent of the draft RPA Acres options were to restore estuary habitat, not necessarily upland habitat. This has been clarified in the final opinion. Options to restore habitat at other sites in the area to benefit Skagit Chinook populations are already provided in the RPA (Acres - Option 2).
District	**Comment No. 16:** The RPAs are not likely to advance recovery goals. Estuarine restoration projects would not significantly improve habitat as the restored area is subsided farmland that would likely be mudflat and would not include any tidal channel habitat.	We disagree that the RPA is not likely to advance recovery goals. To the contrary, 1886 USGS maps indicate that not long after the original tidegate at No Name Slough was installed, the surrounding landscape was marsh habitat. Restoration of habitat as required by the RPA will benefit species. We include an updated description of the historical features in the final biological opinion. In addition, we note that this comment seems contrary to the position supported by the applicant in the TFI Agreement. That Agreement was premised on the understanding that "conversion of up to 2,700 acres of delta agricultural lands [w]as a means to achieve the estuarine habitat restoration and smolt production goals and objectives of the Federally approved Skagit Chinook Recovery Plan, and consistency with Chapter 85 RCW." WWAA et al., 2008, page 4-8
	The RPA should be strengthened.	
Swinomish	650+ acres of outstanding estuary habitat that have not been restored, but which were required to be restored prior to the Joe Leary Slough and Big Ditch tidegate replacements over five years ago.	The bulk of the acreage used to calculate 650 acres was associated with Big Ditch and Joe Leary projects. In the TFI Agreement referencing this 650 acres, the applicable No Name Slough tidegates were determined as needing 8.6 acres. The federal proposed action for this project does not include Joe Leary or Big Ditch tidegate projects.
Swinomish	NMFS must require completion of the RPAs prior to issuance of a construction permit for the replacement of the No Name Slough tidegate. (in other places it says prior to construction) Alternatively, if RPA Completion is not Required Prior to Construction Permit Issuance, then RPA Compliance Should Include Binding Requirements at 1-year Intervals.	"A 'reasonable and prudent alternative' is a flexible standard for the consulting agency; it is not the equivalent of the 'least restrictive alternative.' [T]he [Service] 'need only have adopted a final RPA which complied with the jeopardy standard… .'" *San Luis & Delta-Mendota Water Authority v. Jewell*, 747 F.3d 581, 624 (9th Cir. 2014) (quoting *Sw. Ctr. for Biological Diversity v. Bureau of Reclamation*, 143 F.3d 515, 523 (9th Cir. 1998). The RPA is designed to avoid jeopardizing species and adversely modifying their critical habitat. As explained in the Opinion, in light of the enduring effects of the project over the next 50 years, the RPA meets its purpose even with a 1-3 year delay of certain requirements.

Commenter	Summary/Nature of Comment	Response to Comments
		The RPA requires compliance to be a term of the Corps permit, so if the District fails to comply, there will be a violation of their permit: "A final approved plan for complying with the RPA must be attached to the USACE permit issued for the proposed action and compliance with the RPA must be an enforceable term of the USACE permit. "
Swinomish	The RPAs Must Require In-Kind, In-Place, In-Time Restoration Actions thus Payment of Restoration Funds is Not Appropriate, and Should be Removed from the RPA.	The RPA contains a number of limitations in order to ensure that Skagit River populations are benefitted. For example, Credits-Option 2 requires that habitat improvements must be implemented within Skagit Bay or Padilla Bay. Projects funded under Credits-Option 3 must occur within Skagit Bay or Padilla Bay. Credits-Option 4 is limited to providers with service areas relevant to Skagit Basin PS Chinook salmon. Restoration under Acres-Option 1 must be land adjacent to an existing distributary channel, main channel, or side channel within the Skagit Bay/Padilla Bay area. Acres-Option 2 has a similar limitation.
Swinomish	The Tribe requests that NMFS include an additional RPA that requires the applicant to develop an Implementation Plan to address and improve the grossly out-of-compliance freshwater quality in No Name Slough	We updated the biological opinion to require a water quality improvement plan for No Name Slough as a conservation recommendation.
	INCIDENTAL TAKE STATEMENT	
District	**Comment No. 17:** The reasonable and prudent measures ("RPMs") are not feasible. They alter the basic design, location, scope, duration, or timing of the action, and one of which is already part of the Proposed Action. - RPM No. 1a limits the in-water work to as short a period as possible between July 15th and February 15th. District 12 has requested to install the coffer dam early in the season to allow adequate time to complete the project prior to wet weather - RPM No. 3c requires installation of a tidegate mechanism that delays closing. This has multiple potential problems.	NMFS reviewed the consultation initiation package. In its memorandum accompanying the biological assessment, the USACE stated the project would occur during the in-water work window of July 16 to February 15. The proposed action section of our biological opinion reflects this date. Given the project is already proposed to occur during the in-water work window for the project area, we removed the term and condition, requiring work during this time period, from the Incidental take Statement.

Commenter	Summary/Nature of Comment	Response to Comments
	First, there is no extra storage capacity in the District’s system, so any salt water allowed interior to the site would back up the system and flood landowners. Thus, the implementation of this measure is inconsistent with the purpose of the Proposed Action. Second, salt-water intrusions would reduce and/or eliminate productivity of adjacent farmland. Finally, allowing salt water into the system tends to exacerbate sediment deposition, which results in more frequent needs to clean the channel. [the Corps reiterates this comment on behalf of the Applicant]	

Appendix 5. Calculator output tables for the No Name Slough Tidegate Replacement Project (WCRO-2022-03092). An excel workbook is available upon request.

Figure A5-1. 'Summary' tab of Nearshore calculator output for the No Name Slough tidegate replacement project.

	A	B	C	D
1	Blue cells contain section headings.			
2	Orange cells describe information needed			
3	Grey cells describe units requested for entry			
4	Yellow cells indicate user entry fields			
5	Green cells contain additional explanations, notes, and resource links			
6	Maroon cells contain summary values			
7	Action Agency Reference #			
8	FWS or NMFS #			
9	Project Name:	Padilla Bay Tide Gate		
10–11	Prepared on and by: (Add each update)	SIE & NR 4/18/2024		
12	**Puget Sound Nearshore Habitat Conservation Calculator**			
13		Version 1.6		2/29/2024
14	This tool determines long-term habitat impacts and benefits for projects in the Salish Sea nearshore. Details about the use of this Conservation Calculator can be found in the User Guide, FAQs, and training materials, which are all available on the			
15	Puget Sound Nearshore Habitat Conservation Calculator Webpage			
16			Conservation	DSAYs (Discounted
17	Overwater Structures	Debit	0	0.00
18		Credit (includes creosote removal)	8	0.08
19		Balance	8	0.08
20	Shoreline Armoring	Debit	-423	-4.23
21		Credit from Armor Removal	140	1.40
22		Credit from Creosote Removal	0	0.00
23		Balance	-283	-2.83
24	Maintenance Dredging	Balance	0	0.00
25	Boatramps, Jetties, Rubble	Debit	0	0.00
26		Credit	0	0.00
27		Balance	0	0.00
29	Riparian Enhancement/Degradatio	Balance	0	0.00
30	SAV Planting	Conservation Credit	0	0.00
31	Habitat Loss / Remaining Conservation Offsets Needed		-275	-2.75
32	Is this a standalone restoration project?*	No		
33	* Standalone restoration actions are actions that can be executed outside of a replacement or construction of new structures. They have no negative long term habitat impacts. A standalone restoration action solely restores or improves habitat functions. It does not introduce new or temporally extend adverse effects aside from construction-related effects. Standalone restoration projects include removal of a structure (that has adverse effects) without its replacement.			

Figure A5-2. 'ProjectD' (Part 1 of 2) tab of Nearshore calculator output for the No Name Slough tidegate replacement project.

Project Details

Include all metrics and rationale used to fill out this Calculator. Note where you found all relevant information (JARPA, BE,

Project Name:	Tide Gate
Marine Basin:	North Puget Sound
Location (lat, long):	48.469445, -122.468918
Project Description:	The total length of shoreline armoring being replaced (including the tide gates) at three locations (site #103, #45, #95) is 85'. The width of the dike at these locations is 66'. Excavation of the existing armoring includes the removal of all existing armoring rock. They will excavate below the mudline to install a temporary sheet pile coffer dam. The existing armoring is large rock. Of the 85' of shoreline armoring removed, 62' will be replaced with new large rock (at about 1:2 slope) + 23' of vertical tide gates, rip rap, and concrete. All of the armoring is being strengthened by use of modern compacting requirements (engineering standards), re-stacking of rip rap as well as placement of additional new rip rap, and leaving part of the new sheet pile under the sediment to aid in the prevention of flooding inland. 2 Creosote piles are proposed to be removed with a diameter of 12". length is unknown at this time. Piles are creosote.
Elements entered in this Calculator:	See specific documentation for this project in Padilla Bay Calculator Version 16.docx

Adjustment Factors

Select the adjustment factors and submerged aquatic vegetation (SAV) scenarios for the project location in the yellow boxes below. They will automatically apply to the appropriate tabs. If there is more than one project location, create a separate Calculator with the appropriate adjustment factors for each site, and submit both.

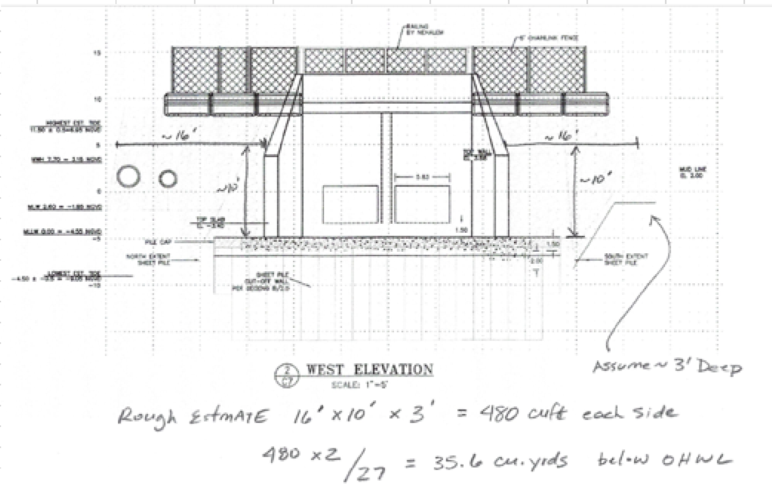
	Yes or No	% Change	Applicable to:	See Applicantion of Factors
Natal Estuary	Yes	90%	All tabs	
Is the project within 5 miles of a Puget Sound Chinook natal estuary or 1 mile of a Hood Canal summer-chum natal estuary? If yes, a factor of 50% applies. A project in both natal estuary and pocket estuary/embayment receives a combined 90% factor.				
Pocket Estuary or Embayment	Yes	0%	All tabs	Explanation of Pocket Estuaries and Embayme
Is the project located within a pocket estuary/embayment? If yes, a factor of 30% applies. If also within a natal estuary zone, a factor of 40% applies.				
Forage Fish Spawning	No	0%	USZ for all tabs	Use WDFW Forage Fish Spawning Map - Wash
Is there sand lance or surf smelt spawning on the project site (as mapped or determined by WDFW)? If yes, a factor of 50% ap				
Same Drift Cell and Updrift of Forage Fish	No	0%	USZ for ShorelStab, BoatRJetty	Use Coastal Atlas "Drift Cells" map layer along with WDFW Forage Fish Spawning
Is the project within the same drift cell *and* updrift of sand lance or surf smelt spawning? If yes, and if there is no forage fish spawning documented on the project site, then a factor of 20% applies.				
Herring Spawning	No	0%	LSZ and DSZ structures in all tabs except RZ	Overwater structures in DSZ herring spawning and holding areas may have herring spawning factor applied depending on size and design. See the User Guide for more information.
Does the project site have documented herring spawning (as mapped or determined by WDFW)? If yes, a factor of 50% applie				
Feeder Bluff	No	0%	RZ, ShorelStab	Use Coastal Atlas "Coastal Landforms" map layer or Beach Slope Reference Line.
Is the project located at a feeder bluff? If yes, a factor of 50% applies.				

USZ Upper Intertidal Vegetation Scenario and LSZ Submerged Aquatic Vegetation (SAV)

Upper Shore Zone	0	Select a number 1 - 3. Scenarios are based on the average plant cover in the footprint of the structure, including a 25-foot buffer. For Shoreline Stabilization, this applies to vegetation in the USZ 25 feet waterward of the project area.
Lover Shore Zone	0	

Figure A5-3. 'ProjectD' (Part 2 of 2) tab of Nearshore calculator output for the No Name Slough tidegate replacement project.

	A	B
42		
43	**Insert project information below to support all entries.**	
44		
45		
46	Length of dike segments where proposed work (restacking of rip rack and installation of 77 cubic yards of new rock) will likely extend the duration of the existance of the dike.	
47	ft	
48	**3**	**Site #103** 2 times the width of the wing walls (BA part 2 Seet C8)
49	**16**	rip rap to be replaced and supplemented with new rock next to wing walls
50	**16**	rip rap on other side of culvert #103
51	**20**	width of armoring at culverts/tide gates
52	**15**	**Site #45 rip rap**- Based on information from email "Response to questions 11182022"
53	**15**	**Site #95 rip rap**- Based on information from email "Response to questions 1118 — I don't know how much new rock would be place – if I had to
54	**62**	**Sum Riprap** — estimate it would be similar to Site #45 – **15-ft** x 10-ft x 3 ft = t450
55	**23**	**Summ armoring at tide gates**



Excerpt form Response to David Price questions 11 18 2022: Site 95 will be done at low-tide in one tide cycle similar to how the old Joe Leary Tidegates were removed (see picture below.) I don't know how much new rock would be place – if I had to estimate it would be similar to Site #45 – **15-ft** x 10-ft x 3 ft = t450 cu.ft = 17 cubic yards.

Figure A5-4. ‘Stablshore’ tab of Nearshore calculator output for the No Name Slough tidegate replacement project.

Impact and Benefit Determination for Shoreline Armoring

		Value	Notes
Elevations and Beach Type	**Input Requests for Elevations and Slope**	**Value**	**Notes**
	Enter the elevation of MHHW (feet) in NAVD 88.		Use the Beach Slope Reference Line GIS layer to find MHHW, HAT, and other information for the site.
	Enter the elevation of HAT (feet) in NAVD 88.		The Beach Slope Reference line elevations are in NAVD 88.
	Typical beach slope:	0.28	This cell is not in use for the adapted NoName Tidegate Calculator
	Horizontal Distance (feet) between MHHW and HAT:	0.00	This cell is not in use for the adapted NoName Tidegate Calculator
Riparian Conditions Post Construction	**Post Construction Riparian Site Conditions Landward of Armoring**		
	Riparian Vegetation Description	**are Feet or Ra**	**Notes**
	Area with bare or impervious surface like concrete, gravel, or sand, within 130 ft behind hard armoring	1	Enter the post-construction riparian conditions here. The inputs reflect the ratio of each riparian habitat type behind armoring. Thus, if just one habitat type is present, it is sufficient to enter a 1 into the respective row. If there is a 50/50 split of the area between two habitat types, enter a 1 into each row for respective habitat types. For more complicated scenarios, enter respective areas. Evaluate *changes* in riparian habitat type in the RZ separately.
	Area with herbaceous vegetation, like lawn, within 130 ft behind hard armoring	1	
	Area with shrubs and trees within 130 ft behind hard armoring	0	
	Entry Block: Removal		
Removal of Existing Armoring	**Input Requests for Removal Armoring**	**Value**	**Notes**
	Length and Type of Shoreline Armoring to be Removed	**Linear feet**	
	Linear feet of the existing armoring that is sloped and/or rock	62	Soft and hybrid armoring do not incur habitat impacts in this calculator. Thus, their removal does not generate credits.
	Linear feet of the existing armoring that is vertical (including concrete, sheet pile, creosote pile or wall).	23	
	Location: Tidal Elevation of Armoring	**Linear feet**	The toe is where the beach meets the armoring. Is your toe elevation in the MLLW datum? Consult the User Guide for instructions to convert to NAVD88. If the toe elevation is unknown, consult the User Guide for an alternative method.
	Enter the toe elevation of the existing armoring in feet in NAVD 88.		
	Horizontal distance (feet) between the toe of the existing armoring and SLR adjusted MHHW:	2.21	This cell is not in use for the adapted NoName Tidegate Calculator
	Conservation offsets gained from old armor removal:	**140.37**	Adjustment factors are already applied to this sub-total.
	Water Quality Benefits for Creosote Removal	**Tons**	Habitat benefits for creosote removal.
	Weight (tons) of creosote timber associated with existing armoring to be removed. 55 cubic ft of creosote treated	0	Reference: Pile Volume Calculator
	Conservation offsets gained from creosote removal:	**0.00**	Adjustment factors are already applied to this sub-total.
	Entry Block: Installation		
Replacements and New Installations	Is this a replacement or repair? Enter "No" if a new structure is being installed.	Yes	
		Value	**Notes**
	Length and Type of Shoreline Armoring to be Installed	**Linear Feet**	
	Linear feet of the armoring that will be sloped or rock?	62	Soft and hybrid armoring do not incur habitat impacts in this calculator. See the User Guide for definitions of soft and hybrid armoring. Vegetation changes associated with soft or hybrid armoring should be entered in the RZ tab.
	Linear feet of the armoring that will be vertical (including concrete, sheet pile, or wood)	23	
	Location: Tidal Elevation of Armoring	**Elevation (NAVD 88)**	
	Enter the toe elevation of the proposed armoring in NAVD 88. For replacements, enter the horizontal distance (feet) between the existing toe and proposed toe below.	NA	The toe of the armoring is where the beach meets the armoring. If the toe elevation is unknown, it may be determined relative to tidal elevations as described in the User Guide.
	Setback: Enter the setback distance (feet) between the existing toe and the proposed toe of the armoring. **Setforward:** If replacement armoring will be located waterward of the existing armoring, enter a minus sign in front of the distance. If the proposed toe will be in the	0	The toe of the armoring is where the beach meets the armoring. For setbacks (proposed armoring will be placed landward of existing armoring), the horizontal distance will be positive. If setforward (proposed armoring will be placed waterward of the existing armoring), the horizontal distance will be negative.
	Habitat loss due to replacement of shoreline armoring	**-423.41**	This value is also displayed in the Summary tab.
	Additional habitat loss due to new shoreline	**0.00**	

Typical Stratified Beach Slopes

Basin	Beach Type	Slope: Link one of these cells	Percent Slope *	Degrees **
Hood Canal	Accretion	0.142	14.2	8.1
Hood Canal	Feeder Bluff	0.28	28	15.6
Hood Canal	FB Exceptional	0.17	17	9.7
Hood Canal	Transport	0.287	28.7	16
North Puget Sound	Accretion	0.191	19.1	10.8
North Puget Sound	Feeder Bluff	0.177	17.7	10
North Puget Sound	FB Exceptional	0.176	17.6	10
North Puget Sound	Transport	0.799	79.9	38.6
South Central Puget Sound	Accretion	0.134	13.4	7.6
South Central Puget Sound	Feeder Bluff	0.316	31.6	17.5
South Central Puget Sound	FB Exceptional	0.26	26	14.6
South Central Puget Sound	Transport	0.295	29.5	16.4
Strait of Juan de Fuca	Accretion	0.126	12.6	7.18
Strait of Juan de Fuca	Feeder Bluff	0.177	17.7	10.04
Strait of Juan de Fuca	FB Exceptional	0.12	12	6.8
Strait of Juan de Fuca	Transport	0.24	24	13.5
Whidbey	Accretion	0.143	14.3	8.14
Whidbey	Feeder Bluff	0.243	24.3	13.66
Whidbey	FB Exceptional	0.241	24.1	13.55
Whidbey	Transport	0.262	26.2	14.68
For sites with "No Appreciable Drift", use the lowest slope value for that basin. For all other beach types, not listed above, use the nearest adjacent beach type. No Appreciable Drift sites often do not need armoring. Consider a soft or hybrid approach.				
* what is a 25% slope?	A 25 % slope is simply a ratio of 25:100. In other words, the ground rises 2.5 inches every 10 inches of horizontal distance.			
** How does percent slope relate to degrees?	A 100 percent slope corresponds to 45 degrees. Convert the slope percentage to a ratio (slope/rise over run) and look up the ratio in a tangent table.			

Figure A5-5. 'Shorelstabiliz USZ install' tab (part 1 of 3) of Nearshore calculator output for the No Name Slough tidegate replacement project.

	A	B	C	D	E	F	G	H	I	J
1	Background Tab for the installation of armoring. Not for User Entry. Cells in this tab have been modified to work together with the entry mask in "ShorelStab".									
2	Nearshore Habitat Service Value Determination Model: Upper Shore Zone Habitat Service Value Determination									
3	Blue cells contain section headings									
4	Rose cells contain questions									
5	Yellow cells in this tab are largely linked to the entry mask.									
6	Grey cells contain units requested for entry									
7	Green cells contain additional explanations									
8	Maroon cells contain summary values									
9	Purple Cells contain zone specific maximum Habitat Service Values									
10	A 1. General Project Factors									
11		Question	Input Format	User Entry	Notes - For more information see Ehinger et al. 2023					
12	Duration	Are the project impacts permanent?	Yes/No	No	Unless project impacts or benefits are permanent make sure to select NO.					
13		If temporary enter years of project impact.	Temp Impact/benefit Years	50	Leave default at 50 years for the design life of hard shoreline armoring. NMFS may change duration for individual cases.					
14	Time Lag	Years Until Full Functioning Habitat	Years	1	If purchasing credits through a bank, enter 1. If calculating for permittee responsible mitigation, enter how many years after the impact full function of mitigation would be achieved. For restoration, the default for achieving full function after restoration in the nearshore marine environment is 3 years. The lowest possible value is 1. Do not enter values less than 1.					
15		Maximum Habitat Service Value for USZ 1	See Ehinger et al. 2023 Chapter 3.3 for determination of maximum habitat service values.	0.6	USZ 1 is MHHW to HAT					
16		Maximum Habitat Service Value for USZ 2		0.9	USZ 2 is +5 MLLW to MHHW					
17	A 2. Area Determinations for Shoreline Stabilization Projects									
18	Automatic Area Calculations for Upper Shore Zone 1 & 2, FYI only, no user input!									
19			Linear feet Before	Linear feet After	SQFT Before	Acres Before	SQFT after	Acres After	Total affected area sum by zone	Check from NoEntryDSAY
20		Length (along shoreline) of area affected in the long term by project. For installation of shoreline armoring that is the length of the armoring.	85.00	85.00						
21	RZ	Potental addition for 2025 Updates								
22										
23	USZ1	Width of Upper Shore Zone 1 **landward** of hard armoring [ft horizontal distance]	0.00	0.00	0	0.000	-	0.000		
24	USZ1	Effective width of Upper Shore Zone 1 [ft horizontal distance] total for before/no armoring, and **waterward** of hard shoreline armoring for after/ column D.	0.00	0.00	0	0.000	0.000	0.000	0.000	0.000
25	USZ2	Width of Upper Shore Zone 2 **landward** of hard armoring [ft horizontal distance]	0.00	66.00	0	0.000	5610.00	0.129	0.129	0.129
26	USZ2	distance] adversely affected area **waterward** of	0.00	0.00	0	0.000	-	0.000		

Figure A5-6. 'Shorelstabiliz USZ install' tab (part 2 of 3) of Nearshore calculator output for the No Name Slough tidegate replacement project.

		Site Conditions for Shoreline Stabilization	Before	After	Notes
27					
28		Site Conditions for Shoreline Stabilization	Before	After	Notes
29	Zones*	Length of shoreline to be altered [ft] - same for before and after.	85.00		* Letters in column are exemplified in the figure on the right.
30	A	Distance of HAT to MHHW [ft horizontal distance].	0.00		Filled out via entry mask tab ShorelStab.
31	B	For hard shoreline armoring: Distance between HAT and shoreline treatment [ft horizontal distance]		66.00	
32	C	Extend of armoring effects waterward of hard armoring. [ft horizontal distance].		0.00	We determined the likely affected area waterward of hard armoring to be limited to 20 feet. We based this estimate on communication with Megan Dethier (Ehinger et al. 2023 Appendix D).
33		"YES" inicates that to be installed hard shoreline armoring is at or waterward of MHHW. "NA" stands for natural, soft, or hybrid condition.	NA	yes	"No" indicates that shoreline armoring is located above MHHW. Scenarios 2&3
34	D	Distance between MHHW and shoreline treatment [ft horizontal distance].		66.00	
35	E	Extent of adverse effects waterward of hard armoring in USZ 2.		0.00	We determined the likely affected area waterward of hard armoring to be limited to 20 feet. We based this estimate on communication with Megan Dethier (Ehinger et al. 2023 Appendix D). For armoring that is placed landward/above MHHW, part of the 20 feet wide affected area will be located in the USZ 1. For those cases, the width diplayed here indicates the affected width located in the USZ 2.
36		The habitat value for areas landward of hard armoring is automatically set to the respective riparian value based on input from the ShorelStab tab. Changes in riparian value should be evaluated in addition.			

Figure A5-7. 'Shorelstabiliz USZ install' tab (part 3 of 3) of Nearshore calculator output for the No Name Slough tidegate replacement project.

	A	B	C	D	E	F	G	H	I	J	K	L
37	B. Habitat Service Value Determination USZ 1&2											
38						Before			After			
39	#	Indicator of Physical and Biological Features	Metrics - Cells are populated through entry mask "ShorelStab"	Percent Influence of Physical and Biological Function on Habitat Service Value	Metric Scores 0 to 1	Site Condition	Category specific Score	Indicator Specific Summary Score	Site Condition	Category specific Score	Indicator Specific Summary Score	Notes
40	Physical and Biological Function: Forage and Cover. Indicator: Beach Logs and Wrack											
41	1a	Habitat Function from large wood and/or beach wrack. Evaluate how much beach wrack and wood are present and what function they provides to site. (Sobocinski et al 2010; Heerhartz et al. 2014, 2016; Strain et al. 2018)	Beach logs and wrack line provide full function. Chose this option for hybrid and soft armoring and natural shoreline.	0.1	1	No	0.00		NA*	0.00		NMFS determined that there is likely no adverse impact related to the installation of soft and hybrid armoring. Thus, the new instalation of soft and hybrid armoring would not be entered in the calculator and the benefits of a replacement of hard armoring with soft or hybrid stabilization would be quantified in the shorel Stbiliz USZ remove tab.
42	1b		Beach logs and wrack line provide medium function. Choose this option for hard armoring above MHHW.		0.5	No	0.00		NO	0.00		
43	1c		Beach logs provide little to no function. Choose this option for shoreline armoring at or below MHHW.		0	Yes	0.00	0.00	yes	0.00	0.00	
44	Physical and Biological Function: Unobstructed Migratory Corridor											
45	For the nearshore structures this model evaluates, the juvenile migratory corridor can be either not availiable, unobstructed, or partially impacted. For situations where the habitat is not availiable (behind hard armoring or taken up by 3D structures including piles and jetties) the after habitat service value is set to the respective riparian value. For OWS the migratorry corridor is still availiable, but obstructed and impacted based on factors including grating and elevation.											
46	2	The model evaluates areas waterward of hard armoring that are accessible to fish. Areas landward of hard armoring automatically receive a habitat service value based on the respective riparian condition and are not evaluated here.	Currently, potential site-specific shading from armoring in the area waterward of armoring has not been included in model considerations. Full site specific scores are given for before and after migratory corridor function.	0.45	1	1.00			1.00			Shading from OWS is evaluated in the USZ tab in the NHVM. Currently, potential site-specific shading from armoring in the area waterward of armoring has not been included in model considerations.
47	Physical and Biological Function: Forage. Indicator: Local Scour					shoreline length in feet			shoreline length in feet			
48	3a	Evaluation of active erosion depending on the typ of armoring. While the process of active erosion in response to shoreline armoring is well established (Prosser et al.,2018), specific effects may vary with key physical parameters including beach slope and location of armoring (Detheir et al, 2016). The type of shoreline armoring can affect the reflective wave rgime and resulting local coarsening of substrate and lowering of beach grade. (Nordstrom, 20014, Detheir et al., 2016)	How many linear feet of the existing or proposed shoreline is natural, soft, or hybrid?	0.1	1.00	100	1.000		0	0.000		The local scour effects on sediments are linked to reduced epibenthic prey production immediately water-ward of hard armoring, although the dynamics are not completely understood (Dugan et al. 2008; Morley et al. 2012; Munsch et al. 2017; Sobocinski et al. 2010; Toft et al. 2010). For example, juvenile chum salmon have been found to consume less epibenthic prey at locations with hard armor compared to unarmored sites (Morley et al. 2012).
49	3b		How many linear feet of the existing or proposed armoring that is "Rock"?		0.20	0	0.000		62	0.146		
50	3c		How many linear feet of the existing or proposed armoring that is "Concrete or Sheetpile"?		0	0	0.000	1.00	23	0.000	0.15	
51	Physical and Biological Function: Forage. Indicator: Sediment Availability											
52	4	Evaluation of effect of hard armoring on local sediment	Yes/No: Reduction of sediment input, interruption of	0.15	1.000		1.000	1.00		0.500	0.50	Full value of 1 assigned for natural, soft, and
53	Physical and Biological Function: Forage and Cover; Indicator: Upper Intertidal Vegetation											
54	5a	Vegetation Condition, selection takes place in ProjectD tab.	Select "Yes" if area with elevation that would support saltmarsh vegetation is covered with >60% of upper intertidal vegetation including macro algae	0.1	1.00	No	0.00		No	0.00		
55	5b		Select "Yes" if area with elevation that would support salmarsh vegetation is covered with >30% and <60% of upper intertidal vegetation including		0.75	No	0.00		No	0.00		
56	5c		Select "Yes" if area with elevation that would support salmarsh vegetation is covered with >5% and < 30% of upper intertidal vegetation including macro		0.50	No	0.00		No	0.00		
57	5d		Select "Yes" if area with elevation that would support salmarsh vegetation is covered with <5% of upper intertidal vegetation including macro algae and saltmarsh vegetation like Salicornia sp. and Disticilis sp..		0.25	Yes	0.25	0.25	Yes	0.25	0.25	
58	Physical and Biological Function: Chemical Water and Sediment Quality											
59	6a	Evaluate change in contaminants in water quality and sediment quality condition. Select one condition for before and after.	Good	0.1	1.00	No	0.00		No	0.00		
60	6b		Medium		0.50	Yes	0.50		Yes	0.50		
61	6c		Poor		0.00	No	0.00	0.50	No	0.00	0.50	
62	Habitat Value without discounting to max per zone			1			NHV	0.775		NHV	0.615	NHV times max HSV for USZ 1
63	DSAYs for USZ 1		0.00000									
64	DSAYs for USZ 2		-2.22845									
65	Sum DSAYs Shoreline Stab USZ		-2.22845									

Figure A5-8. ‘Shorelstabiliz USZ remove tab’ (part 1 of 4) of Nearshore calculator output for the No Name Slough tidegate replacement project.

	A	B	C	D	E	F	G	H
1	Background Tab for the removal of armoring. Not for User Entry. Cells in this tab have been modified to work together with the entry mask in "ShorelStab"							
2	Nearshore Habitat Service Value Determination Model: Upper Shore Zone Habitat Service Value (HSV) Determination							
3	Blue cells contain section headings							
4	Rose cells contain questions							
5	Yellow cells in this tab are largely linked to the entry mask.							
6	Grey cells contain units requested for entry							
7	Green cells contain additional explanations							
8	Maroon cells contain summary values							
9	Purple Cells contain zone specific maximum Habitat Service Values							
10	A 1. General Project Factors							
11		Question	Input Format	User Entry	Notes - For more information see Ehinger et al. 2023			
12	Time Duration	Are the project impacts/benefits permanent?	Yes/No	No	If project impacts or benefits are not permanent make sure to select NO.			
13		If temporary enter years of project benefit.	Years	10	Standard benefit duration for structure removal of structures in functioning condition is 10 years unless extended on a case-by-case basis with a site protection instrument.			
14		Years Until Full Functioning Habitat	Years	1	For removal enter 1 unless there is information that re-establishment of functions would likely take longer. **Do not enter values less than 1.**			
15		Maximum Habitat Value for USZ 1		0.6	USZ 1 is MHHW to HAT			
16		Maximum Habitat Value for USZ 2		0.9	USZ 2 is +5 MLLW to MHHW			
17	A 2. General Project Factors for Shoreline Stabilization and Restoration Projects							
18	Automatic Area Calculations for Upper Shore Zone 1 & 2, FYI only, no user input!							
19			Linear feet Before	Linear feet After	SQFT waterward in respective USZ Before	Acres Before	SQFT waterward in respective USZ after	Acres After
20		Length (along shoreline) of area affected in the long term by project. For installation of shoreline armoring that is the length of the armoring.	85.00	85.00				
21		Potental addition for 2025 Updates						
22	RZ							
23	USZ1	slope distance]	0.00	0.00	0	0.000	-	0.000
24	USZ1	for before/no armoring, and waterward of hard shoreline	0.00	0.00	0	0.000	-	0.000
25	USZ2	horizontal distance]	66.00	0.00	5610	0.129	-	0.000
26	USZ2	adversely affected area waterward of hard shoreline armoring in	0.00	0.00	0	0.000	-	0.000

Figure A5-9. ‘Shorelstabiliz USZ remove’ tab (part 2 of 4) of Nearshore calculator output for the No Name Slough tidegate replacement project.

27					
28		Site Conditions for Shoreline Stabilization	Before	After	Notes
29	Zones*	Length of shoreline to be altered [ft] - same for before and after.	85.00		* Letters in column are exemplified in the figure on the right.
30	A	For natural shoreline and soft shore treatments: Distance of HAT to MHHW [ft horizontal distance]. For hard armoring leave empty and fill out B		0.00	Depending on soft shore or hard shore fill in A or B.
31	B	For hard shoreline armoring: Distance between HAT and shoreline treatment [ft horizontal distance]	66.00	0.00	
32	C	Extend of armoring effects waterward of hard armoring. [ft horizontal distance].		0.00	We determined the likely affected area waterward of hard armoring to be limited to 20 feet. We based this estimate on communication with Megan Dethier (Ehinger et al. 2023, Appendix D).
33		"YES" indicates that hard shoreline armoring is at or waterward of MHHW. "NA" stands for natural, soft, or hybrid condition.	yes	NA	"No" indicates that shoreline armoring is located above MHHW.
34	D	Distance between MHHW and shoreline treatment [ft horizontal distance].	66.00	na	
35	E	Extent of adverse effects waterward of hard armoring in USZ 2.	0.00		We determined the likely affected area waterward of hard armoring to be limited to 20 feet. We based this estimate on communication with Megan Dethier (Ehinger et al. 2023, Appendix D). For armoring that is placed landward/above MHHW, part of the 20 feet wide affected area will be located in the USZ 1. For those cases, the width diplayed here indicates the affected width located in the USZ 2.
36		The habitat value for areas landward of hard armoring is automatically set to the respective riparian value based on input from the ShorelStab tab. Changes in riparian value should be evaluated in addition.			

Figure A5-10. ‘Shorelstabiliz USZ remove’ tab (part 3 of 4) of Nearshore calculator output for the No Name Slough tidegate replacement project.

B. Habitat Service Value Determination USZ 1&2											
					Before			After			
#	Indicator of Physical and Biological Features	Metrics - Cells are populated through	Percent Influence	Metric Scores 0 to	Site Condition	Category specific Score	Indicator Specific	Site Condition	Category specific Score	Indicator Specific	Notes
Physical and Biological Function: Forage and Cover. Indicator: Beach Logs and Wrack											
1a	Habitat Function from large wood and/or beach wrack. Evaluate how much beach wrack and wood are present and what function they provides to site. (Sobocinski et al 2010; Heerhartz et al. 2014, 2016; Strain et al. 2018)	Beach logs and wrack line provide full function. Chose this option for hybrid and soft armoring and natural shoreline.	0.1	1	No	0.00		No	0.00		NMFS determined that there is likely no adverse impact related to the installation of soft and hybrid armoring. Thus, the new instalation of soft and hybrid armoring would not be entered in the calculator and the benefits of a replacement of hard armoring with soft or hybrid stabilization would be quantified in the shorel Stbiliz USZ remove tab.
1b		Beach logs and wrack line provide medium function. Choose this option for hard armoring above MHHW.		0.5	NO	0.00		No	0.00		
1c		Beach logs provide little to no function. Choose this option for shoreline armoring at or below MHHW.		0	yes	0.00	0.00	Yes	0.00	0.00	
Physical and Biological Function: Unobstructed Migratory Corridor											
For the nearshore structures this model evaluates, the juvenile migratory corridor can be either not availiable, unobstructed, or partially impacted. For situations where the habitat is not availiable (behind hard armoring or taken up by 3D structures including piles and jetties) the after habitat service value is set to the respective riparian value. For OWS the migratory corridor is still availiable, but obstructed and impacted based on factors including grating and elevation.											
2	The model evaluates areas waterward of hard armoring that are accessible to fish. Areas landward of hard armoring automatically receive a habitat service value based on the respective riparian condition and are not evaluated here.	Currently, potential site-specific shading from armoring in the area waterward of armoring has not been included in model considerations. Full site specific scores are given for before and after migratory corridor function.	0.45	1	1.00			1.00			Shading from OWS is evaluated in the USZ tab in the NHVM. Currently, potential site-specific shading from armoring in the area waterward of armoring has not been included in model considerations.
Physical and Biological Function: Forage. Indicator: Local Scour					shoreline length in feet			shoreline length in feet			
3a	Evaluation of active erosion depending on the typ of armoring. While the process of active erosion in response to shoreline armoring is well established (Prosser et al.,2018), specific effects may vary with key physical parameters including beach slope and location of armoring (Dethier et al, 2016). The type of shoreline armoring can affect the reflective wave rgime and resulting local coarsening of substrate and lowering of beach grade. (Nordstrom, 20014, Dethier et al., 2016)	How many linear feet of the existing or proposed shoreline is natural, soft, or hybrid?	0.1	1.00	0	0.000		85	1.000		The local scour effects on sediments are linked to reduced epibenthic prey production immediately water-ward of hard armoring, although the dynamics are not completely understood (Dugan et al. 2008; Morley et al. 2012; Munsch et al. 2017; Sobocinski et al. 2010; Toft et al. 2010). For example, juvenile chum salmon have been found to consume less epibenthic prey at locations with hard armor compared to unarmored sites (Morley et al. 2012).
3b		How many linear feet of the existing or proposed armoring that is "Rock"?		0.20	62	0.146		0	0.000		
3c		How many linear feet of the existing or proposed armoring that is "Concrete or Sheetpile"?		0	23	0.000	0.15	0	0.000	1.00	
Physical and Biological Function: Forage. Indicator: Sediment Availability											
4	Evaluation of effect of hard armoring on local sediment supply. Hard armor prevents upland sediments from entering the USZ, prevents landward migration of shorelines, and can interrupt longshore drift. These effects results in cumulative and drift-cell wide impacts, including modification of beach profile and texture (Dethier et al. 2016b; Dugan et al. 2011; Whitman and Juans 2011; Whitman 2014).	Yes/No: Reduction of sediment input, interruption of longshore drift, prevention of landward migration of shoreline,	0.15	1.000		0.500	0.50		1.000	1.00	Full value of 1 assigned for natural, soft, and hybrid. Value assigned for hard armoring 0.5. Consideration of bluffs is included through adjustment factor.

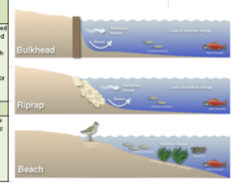


Figure A5-11. ‘Shorelstabiliz USZ remove’ tab (part 4 of 4) of Nearshore calculator output for the No Name Slough tidegate replacement project.

Physical and Biological Function: Forage and Cover; Indicator: Upper Intertidal Vegetation											
5a	Vegetation Condition, selection takes place in ProjectD tab.	Select "Yes" if area with elevation that would support saltmarsh vegetation is covered with >60% of upper intertidal vegetation including macro algae and saltmarsh vegetation like Salicornia sp. and Distichlis sp.	0.1	1.00	No	0.00		No	0.00		Bulkhead Removal: At locations with existing shorline armoring it is often difficult to determine whether any salmarsh vegetation will re-establish after removal of hard armoring. Thus, unless the surrounding location gives strong indication for vegetation establishment, the defualt after condition is the same as the before condition when evaluating bulkhead removal. NMFS biologists can adjust the after condition if warranted.
5b		Select "Yes" if area with elevation that would support salmarsh vegetation is covered with >30% and <60% of upper intertidal vegetation including macro algae and saltmarsh vegetation like Salicornia sp. and Disticilis sp.		0.75	No	0.00		No	0.00		
5c		Select "Yes" if area with elevation that would support salmarsh vegetation is covered with >5% and < 30% of upper intertidal vegetation including macro algae and saltmarsh vegetation like		0.50	No	0.00		No	0.00		
5d		Select "Yes" if area with elevation that would support salmarsh vegetation is covered with <5% of upper intertidal vegetation including macro algae and saltmarsh vegetation like Salicornia sp. and Disticilis sp..		0.25	yes	0.25	0.25	yes	0.25	0.25	
Physical and Biological Function: Chemical Water and Sediment Quality											
6a	Evaluate change in contaminants in water quality and sediment quality condition. Select one condition for before and after.	Good	0.1	1.00	No	0.00		No	0.00		
6b		Medium		0.50	Yes	0.50		Yes	0.50		
6c		Poor		0.00	No	0.00	0.50	No	0.00	0.50	
Habitat Value without discounting to max per zone			1			HSV	0.615		HSV	0.775	
DSAYs for USZ 1		0.00000							HSV USZ 1	0.46	NHV times max HSV for USZ 1
DSAYs for USZ 2		0.73880									
Sum DSAYs Shoreline Stab USZ		0.73880									