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

Refer to NMFS No:
WCRO-2019-02459

November 30, 2023

Chris Beck, LEED-AP
Division Chief
Environmental Division
Directorate of Public Works
Joint Base Lewis-McChord, Washington 98433-9500

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Joint Base Lewis McChord Solo Point Boat Ramp, Culvert Replacement, and Shoreline Stabilization

Dear Mr. Beck:

Thank you for your letter on September 4th, 2019, 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 Joint Base Lewis McChord Solo Point Boat Ramp, Culvert Replacement, and Shoreline Stabilization. Thank you for subsequent information regarding erosion control, riparian plantings, and stream restoration. This information has been included in the proposed action and this consultation.

Thank you for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action. We concluded that the action would adversely affect the EFH of Pacific Coast Groundfish, Coastal Pelagic Species, and Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document. EFH recommendations have been provided and require a response from the Army within 30 days.

In this opinion, we conclude that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon (*Oncorhynchus tshawytscha*), PS steelhead (*O. mykiss*), and Southern Resident killer whale (SRKW; *Orcinus orca*).

Please contact Nissa Rudh in the Lacey, Washington, office at 360-701-9699 if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Sean Callahan (Army – Project Biologist)
Rocky Lightfoot (Army – Engineer)

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

Joint Base Lewis McChord Solo Point Boat Ramp, Culvert Replacement, and Shoreline Stabilization

NMFS Consultation Number: WCRO-2019-02459

Action Agency: United States Department of the Army

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 Adversely Modify Critical Habitat?
Puget Sound Steelhead (*Oncorhynchus mykiss)*	Threatened	Yes	No	NA	NA
Puget Sound Chinook (*O. tshawytscha)*	Threatened	Yes	No	NA	NA
Puget Sound/Georgia Basin Yelloweye Rockfish (*Sebastes ruberrimus)*	Threatened	No	NA	NA	NA
Puget Sound/Georgia Basin Bocaccio (*Sebastes paucispinis)*	Endangered	No	NA	NA	NA
Southern Resident Killer whale *(Orcinus area)*	Endangered	Yes	No	NA	NA

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Pacific Coast Groundfish	Yes	Yes
Coastal Pelagic Species	Yes	Yes

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

Issued By:

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

Date: November 30, 2023

TABLE OF CONTENTS

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.), as amended, and implementing regulations at 50 CFR part 402.

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

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

1.2. Consultation History

On September 4th 2019, NMFS received a letter from the Department of the Army requesting consultation for the replacement of three existing boat ramps at Solo Point on the Joint Base Lewis-McChord (JBLM) with one larger boat ramp. The project also would place 193 boulders between the beach and parking area to prevent vehicles from driving onto the beach. A Biological Assessment (BA) was also received by NMFS from the Army at this time. Assignment of this project to a NMFS biologist was delayed due to high workload and low staffing.

In March of 2021, a project biologist was assigned. On her review initial review, the biologist suggested site-specific improvements that would enhance habitat for listed species at the site, including daylighting the perennial stream associated with Culvert 1.

In early April of 2021, the Army submitted additional documents supporting the Solo Point section 7 consultation including a boat ramp maintenance plan. The biologist followed up with a list of questions and suggestions for the project. The Army's responses to NMFS suggestions to 1) reduce the number of boulders, 2) reduce the size of the new boat ramp, 3) daylight the perennial stream that runs under the parking lot were considered unfeasible.

In late April of 2021, the Army notified NMFS on a phone call that an erosion control element was being added to the project. In an email response NMFS requested the Army submit an addendum or memo detailing the new project elements and updated site drawings that include Highest Astronomical Tide (HAT).

In May of 2021, the Army provided NMFS with updated project plans that included erosion control measures, culvert maintenance, and riparian plantings on the site.

In July, 2021, the Army provided a draft Conservation Calculator for the project. In August 2021, NMFS and the Army, had a (phone) meeting to discuss project elements, possible offsets, and how a replacement project could display long term habitat loss in the Conservation Calculator. NMFS provided a list of questions to refine the calculator entry.

September 2021 through January 2022, NMFS and the Army exchanged emails regarding project details and possible elements to mitigate impacts.

July 2022, the Army proposed to use another project occurring on the JBLM property to offset the Solo Point project. The proposed mitigation was for a flow control project between Sequalitchew lake and Sequalitchew creek. Because this creek has a downstream barrier, and benefits to water quality were not defined in the project materials, NMFS requested that the Army describe and quantify how the mitigation would offset impacts to estuarine features as listed in our critical habitat listings: unobstructed migratory corridor, forage, water quality, sediment quality and quantity; as well as address the positive impacts to viable salmon populations. No description was received. NMFS determined this site was not suitable to offset estuarine impacts because the mitigation was in the freshwater area.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

March 2023, NMFS reached out to the Army to attempt to kickstart consultation. The Army expressed desire to complete consultation ASAP. The Army added beach nourishment to the proposed action.

March 17, 2023, the project Conservation Calculator analysis was upgraded to V1.5, resulting in additional habitat loss due to decreased benefits of riparian plantings without an easement. Output changed to -155 and included beach nourishment proposed.

April 5, 2023, the Army provided updated photos and project drawings of the project to NMFS. These have been used in this Biological Opinion.

April 10, 2023, NMFS provided a draft proposed action to the Army to confirm the current proposed action and confirm that the ESA consultation would be formal, not informal.

April 13, 2023, the Army sent a revised final project description and a Memorandum for Record on Nisqually tribe's consultation and concurrence with the project.

September 7, 2023, the Army indicated electronically they would add a project element to daylight the extant stream on site instead of repairing Culvert 1 and Culvert 2 and to include it in this Biological Opinion's analysis.

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). Under MSA, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken by a federal agency (50 CFR 600.910). Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910).

The project is proposed by the United States Department of the Army (Army) and is located at Solo Point (47.138965, -122.631659), a spit of land jutting into the nearshore of the Salish Sea on the Joint Base Lewis-McChord (JBLM) in Pierce County, Washington. Solo Point is designated Solo Point Amphibious Site A-1 and is a military facility delegated for access to marine waters for amphibious training operations. The action, funded by the Army, includes multiple elements, and Army Corps of Engineers Clean Water Act Permits would also be required elements of this action. See Figures 1 and 2 below for the relative location of Solo Point and a satellite image of the point.

Summary list of elements within the proposed action:

- Boat ramp replacement and expansion
- Debris removal (imbedded tires, and concrete)
- Soft shore armoring including: regrading, large wood placement, and planting vegetation
- Stormwater treatment
- Rock placement to prevent vehicular access
- Creation of pedestrian access areas
- Invasive plant removal and herbaceous native plant plantings
- Installation of a vegetative filter strip to treat stormwater
- Long-term maintenance activities

We considered, under the ESA, whether the proposed action would cause any other activities and determined that due to previous consultations with NMFS regarding vessel use and the active JBLM INRMP, no additional activities would occur but for this action.

Figure 1. Google Earth satellite imagery of Solo Point taken during a low tide in August, 2020. Trucks with trailers provide size reference

Three boat ramps exist currently at Solo Point, but only one is considered partially usable. The Army proposes to demolish and remove the three existing boats ramps, concrete rubbish and, tires embedded in the shore. The extant ramps would be replaced with a new, 20-foot wide and 200-foot long cast-in-place concrete boat ramp bordered with four-foot-wide open-cell concrete matting on each side (28-foot wide total). In addition, approximately 90 boulders would be placed along the beach above MHHW with three pedestrian access points to prevent vehicle access to the adjacent beach. No curbs are proposed on either side of the boat ramp. The boat ramp would not be elevated; it would match the natural grade and would be level with the surrounding beach. See Figures 2 and 3 below.

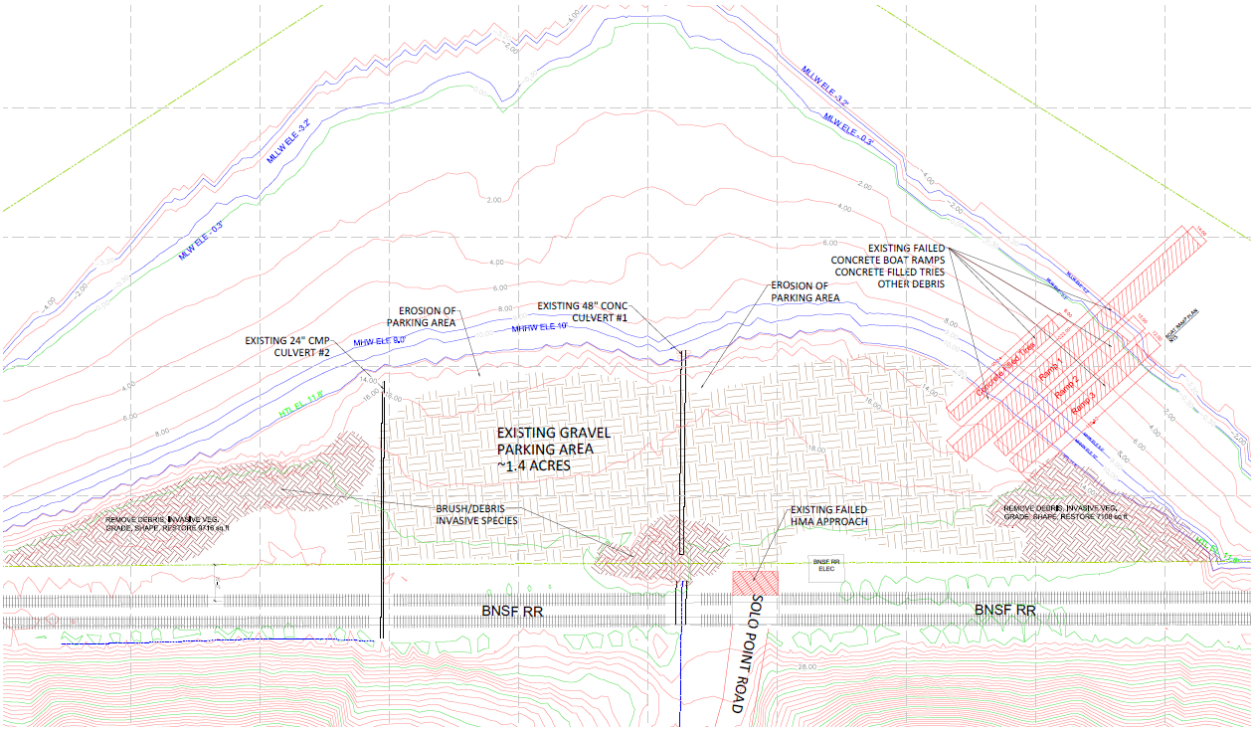

Figure 2. Existing site plan showing three extant ramps, tire debris, existing gravel parking area, the Burlington Northern Santa Fe (BNSF) Railway and culverts (one non-functional and other draining a perennial stream)

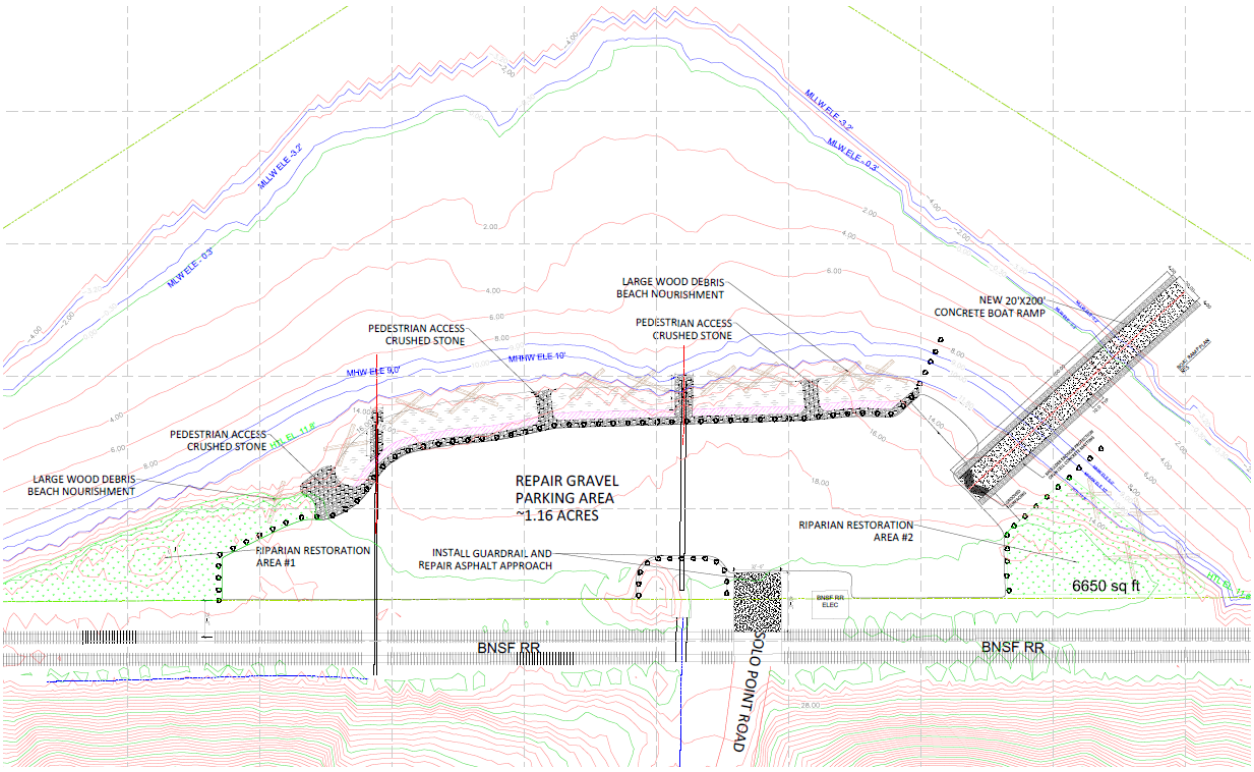

Figure 3. Proposed site plan with replacement boat ramp, hybrid shoreline armoring, plantings, pedestrian access locations, and boulder placement.

Use of equipment on the beach would be confined to a single access point, and limited to a 12-foot work corridor on either side of the proposed work. Equipment would be operated from the parking area, on existing concrete, on a temporary work platform, or similar out-of-water location.

All shore located work would take utilizing low tides to the extent practicable. A floating turbidity curtain surrounding a cofferdam would be used to dewater and contain sediment during the in-water work. Equipment staging would occur in the existing parking lot to minimize impacts to the beach. Solo Point Road would provide vehicle and equipment access. Solo Point would be closed to all civilian and military recreational or training during construction.

The Army proposes to grade up to 210 feet long and 30 feet wide of the shore. lay filter fabric w a six-inch layer of 1 ¼-inch clean crushed rock then concrete will be cast-in-place in sections for the entire length of the ramp. During concrete casting, dewatering efforts shall continue for 3 days to allow concrete to cure. Open-cell concrete matting would be installed on both sides using connection plate assemblies secured with anchor cable. This portion proposed action would be completed within one month, to occur between July 16 to February 15. In order to ensure no impacts to forage fish spawning, a qualified biologist would perform a survey and confirm in writing that no forage fish are spawning in the project area during the proposed construction. If forage fish are present in the project area, then the US Fish and Wildlife Service and National Marine Fisheries Service would be contacted to discuss if the work window for that species applies.

Boat ramp maintenance activities would occur between July16 and September 30 for the design life of the ramp. Maintenance includes: (1) The removal of sand and gravel from within the boat launch footprint and placement of the material on the downdrift side of the boat launch at the Ordinary High-Water Line. (2) Removal of untreated wood from within the boat launch footprint and placement on the downdrift side of the boat ramp at or waterward of the Ordinary High-Water Line. (3) Removal of treated wood from Waters of the United States (WOTUS) and disposal of treated wood at an upland disposal site.

The following measures would be employed during boat ramp maintenance.

1. Equipment would not be operated on the beach outside the footprint of the existing boat ramp.
2. Maintenance activities, including relocation of material, would be conducted when the work area is not inundated by tidal waters.
3. Sediment removed from the boat ramp would be placed at the ordinary high-water line and downdrift of the structure. Material would spread out laterally along the ordinary high-water line such that placement of material should not exceed one cubic yard per linear foot of shoreline.
4. Untreated wood removed from the boat ramp would be placed at or waterward of the ordinary high-water line and downdrift of the structure.
5. Treated wood would be removed entirely and disposed of at an upland disposal site.

If large woody debris extending beyond the edge of the ramp is preventing the use of the boat ramp outside of the work window (July 16 - Sept 30, assuming forage fish presence), the JBLM Directorate of Public Works, Environmental Division, would be contacted prior to removal. Additionally, a forage fish beach survey, conducted by an approved WDFW biologist, would occur prior to removal if work would occur outside the forage fish work window. Woody debris contained within the footprint of the ramp would be removed at any time and deposited at the OHWM downdrift of the ramp

Erosion Control and Native Plantings:

The Army proposes a soft armoring system around the parking area that would be re-sloped and revegetated to support riparian native species consistent with the Washington Department of Fish and Wildlife Marine Shoreline Design Guide (2014) chapter 7 (MSDG). The soft shore armored banks would be re-sloped and revegetated with herbaceous native species that would reduce the gradient of the slope and increase stability. The eroded edge of the parking area would be laid back to a maximum slope of 4:1 to allow for replanting of riparian species. Boulders would be strategically placed to prevent vehicle access to the beach area. This element is anticipated to take up to 60 days, within the IWWW, to occur during low tide. Work above the HTL may occur outside the IWWW and will follow the proposed minimization measures listed below. As above, If forage fish are present, the work window would narrow to from July 16 to September 30 for surf smelt, to October 14 for sand lance, or to Jan 14 for Pacific herring. As above, if forage fish are present, the work window would narrow to from July 16 to September 30 for surf smelt, to October 14 for sand lance, or to Jan 14 for Pacific herring. If forage fish may be present, a WDFW biologist may visit the site and confirm that no spawning forage fish would be affected by construction to extend the window to Feb 15th.

Approximately 262 cubic yards of beach nourishment would be place on site mitigate erosion of the upper beach and backshore areas and enhance habitat.

Removal of concrete and wood bunkers

Various pieces of concrete and wood bunkers would be removed as part of the action. The stockpile of fill material shall be removed, shaped, and graded to match the surrounding grade. Invasive species will be removed from these locations and replanted with native species (see below).

Native Riparian Plantings

The soft shore armored banks would be re-sloped and revegetated with herbaceous native species. On the north side of Solo Point, approximately 6,650 square feet of riparian would be cleared of invasive species and planted with native herbaceous species. On the south side of Solo Point, a similarly sized area would also be restored with native herbaceous species. In total, approximately 12,800 square feet of herbaceous vegetation would be planted between the north, south, and soft armoring areas. See Figure 3 above.

Daylighting the on-site Stream

Culvert 1, draining a perennial stream, and Culvert 2, draining the BSNF railway bed, would be decommissioned and the stream would be daylighted. In lieu of Culvert 1, a new channel would be excavated from the Burlington Northern line, waterward to the confluence with the Puget Sound, which will be relocated several hundred feet to the south of its current drainage point at Solo Point. See Figure 4 below.

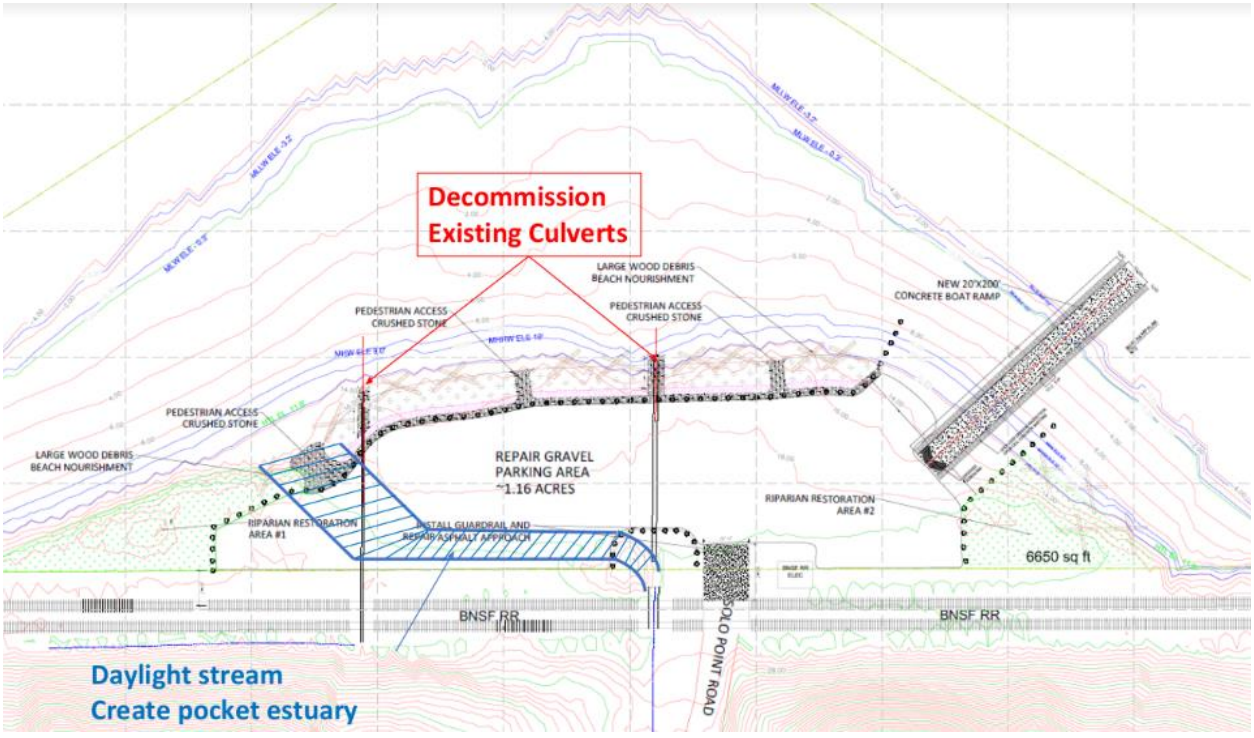

Figure 4. Draft project drawing of daylighted stream and decommissioned culverts

Stormwater Treatment

The Army will install a five-foot wide by six-inch deep sheet flow dissipation/dispersion strip and five feet wide vegetated filter strip, at the top of the re-sloped areas to prevent channelization, provide stormwater treatment, and to prevent sediment delivery to the Puget Sound from parking area stormwater runoff. The treatment would be sized according to Ecology design criteria in the Stormwater Management Manual for Western Washington. See Figure 5 below.

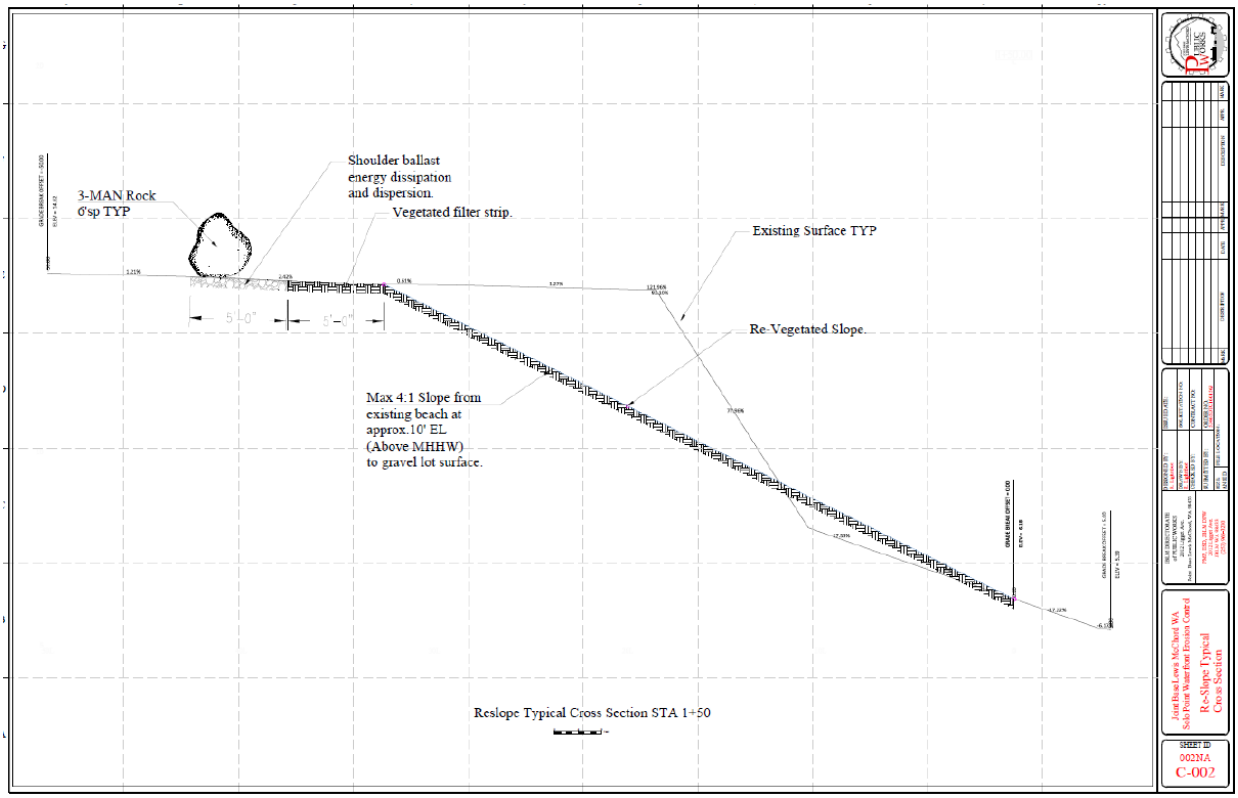

Figure 5. A shoreline cross section plan for erosion control at Solo Point showing soft shore armoring as "re-vegetated slope", a vegetated filter strip, dispersion strip, and boulder placement.

Proposed Minimization Measures

In addition to the project elements described above, the following conservation measures and best management practices would be implemented by the Army and are intended to reduce impacts to ESA-listed species:

- Any disturbance of the beach area by construction activities or equipment, would be restored to the original pre-project conditions upon the immediate completion of construction.
- Existing habitat features such as native vegetation and large wood would be retained on-site, to the extent possible.
- Contractor shall submit a preconstruction environmental protection plan and a storm water pollution prevention plan (SWPPP).
- A pre-construction meeting would be conducted to look at existing conditions and any possible fine-tuning that should be done for BMPs or environmental requirements. The

pre-construction meetings would include outside resources agencies like USFWS or NMFS.

- If fish or other wildlife are observed in distress or if a fish kill occurs, work would be stopped immediately and necessary agencies would be contacted and work would not resume until the issue is resolved.
- Equipment used near and in the water would be cleaned prior to construction.
- Drive trains would not work in the water. Only the excavator bucket with thumb attachment would extend into the water.
- Care would be taken to prevent any petroleum products, chemicals, or other toxic or deleterious materials from construction equipment and vehicles from entering the water.
- A spill containment kit, including oil-absorbent materials would be kept on-site during construction.
- Construction would halt in the event of a spill or if any oil product is observed in the water. If a spill were to occur, work would be stopped immediately, steps would be taken to contain the material, and appropriate agency notifications would be made.
- Fueling would occur off the beach, and biodegradable hydraulic fluids would be used as appropriate in any portion of the equipment that would work in the water.
- Turbidity and other water quality parameters would be monitored to ensure construction activities conform with the protocols and criteria in the Washington Department of Ecology (Ecology) Water Quality Certification (WQC).
- A sediment fence would be installed around where construction vehicles would be parked and their path to the work zone to prevent surface flow and potential erosion occurring during construction.
- Staging would occur in the existing gravel parking lot adjacent to the boat ramps.

1.4. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The proposed project located in the nearshore intertidal zone of the South Puget Sound, along Cormorant Passage. The action area is determined by the outer boundary of any physical, chemical, or biological changes in the environment caused by the proposed action. The action area includes the entirety of Solo Point waterward of the Burlington Northern Railroad (47.138314, -122.632513).

Due to the persistent nature of water quality contaminants associated with stormwater, the action area extends into the nearshore beyond the turbidity mixing zone. However, based on the low amount of vehicular traffic at this site, we expect water and sediments to be affected by certain likely contaminants (PAHs, and 6PPD-Q, for example) will be well below the one kilometer (km) radius identified by (Zhang et al 2016). Despite the proposed stormwater treatment, we estimate that chemicals may be detectable radially 500 radially from Solo Point into Puget Sound. See Figure 6 below.

Figure 6. 500-foot action area radius extending waterward from that includes Solo Point and the adjacent nearshore.

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 provides an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an 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 a jeopardy 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 does not evaluate designated critical habitats because JBLM was excluded from critical habitat per the Sikes act of 1997. (70 FR 52629 (2006); 79 FR 68041 (2014); 86 FR 41668 (2014)). The Army, in conjunction with JBLM has an active Integrated

Resource Management Plan (INRMP) (JBLM, 2019) and Endangered Species Management Components (ESMC), or "ESMPs – Plans" for listed salmon, steelhead (JBLM, 2013a), and rockfish species (JBLM 2013b). These plans are administered by the JBLM Public Works Environmental and Natural Resources Division.

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. Evaluate the rangewide status of the species expected to be adversely affected by the proposed action:

- Evaluate the environmental baseline of the species t.
- Evaluate the effects of the proposed action on species 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, analyze whether the proposed action is likely to: 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
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

For this consultation, NMFS also evaluated the project using a Habitat Equivalency Analysis (HEA)[1] and the Puget Sound Nearshore Habitat Values Model (NHVM) adapted from Ehinger et al. 2015 via the Puget Sound Nearshore Habitat Conservation Calculator (Conservation Calculator). This model was used to quantify the enduring in-water and riparian habitat effects of the proposed action on ESA listed salmonids. Impacts are expressed in Discounted Service Acre Years (DSAYs)*100. The Conservation Calculator does not evaluate construction effects (example: pile driving or turbidity), freshwater effects, nor does it evaluate impacts caused by stormwater or pollution generating impervious surfaces (PGIS).

Ecological equivalency, that forms the basis of the Conservation 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

[1] A common "habitat currency" to quantify habitat impacts or gains can be calculated using Habitat Equivalency Analysis (HEA) methodology when used with a tool to consistently determine the habitat value of the affected area before and after impact. NMFS selected HEA as a means to identify section 7 project related habitat losses, gains, and quantify appropriate mitigation because of its long use by NOAA in natural resource damage assessment to scale compensatory restoration (Dunford et al. 2004; Thur 2006) and extensive independent literature on the model (Milon and Dodge 2001; Cacela et al. 2 2005; Strange et al. 2002). In Washington State, NMFS has also expanded the use of HEA to calculate conservation credits available from fish conservation banks (NMFS 2008, NMFS 2015b)), from which "withdrawals" can be made to address mitigation for adverse impacts to ESA species and their designated critical habitat.

can be fully offset by the services gained from a conservation activity. In this case, we use this approach to quantify the impacts of certain enduring effects of the proposed action. NMFS has a webpage with general information, frequently asked questions, and a downloadable Conservation Calculator and User Guide here: https://www.fisheries.noaa.gov/west-coast/habitat-conservation/puget-sound-nearshore-habitat-conservation-calculator.

The Conservation Calculator is also a tool for demonstrating sufficient conservation offsets and demonstrating no long-term net loss for projects consulted under the Salish Sea Nearshore Programmatic (signed June 29, 2022).

Output from the Conservation Calculator accounts for the following consequences of the action:

- Beneficial aspects of proposed projects, including any positive nearshore effects that would result from removing a structure, or piece of a structure, prior to the end of any remaining "useful life period";
- Minimization incorporated through project design improvements (e.g., credit is given for removal of debris, or replacement of creosote piles with steel piles as steel piles typically have less impact on water quality);
- Adverse effects that would occur for the duration of a new "useful life period" that would result from proposed expanded, new, or repaired or replaced structures (or components of existing structures).

Long term impacts caused by the Solo Point proposed action were evaluated with V1.5 of the Conservation Calculator, released February 2023. The final output of the project calculator, entered to the best of NMFS' knowledge, is -155 (-1.55 DSAYs). This output of -155 based on an assumption within the Calculator itself that riparian plantings have a relatively low success rate over time. However, the extant JBLM Endangered Species Management Plan for salmonids focuses on the maintenance of riparian buffers, invasive removal, and native plantings adjacent to freshwater streams. Due to JBLM Directorate of Public Works Environmental Division's commitment to maintain and protect riparian areas through this ECMP, the rockfish ECMP, and their active INRMP, we believe plantings will be maintained for survival and reach their full habitat potential on site. Accordingly, this would adjust the habitat value associated with those plantings. This adjustment, while not reflected in the calculator output, would increase habitat benefits, effectively raising the negative number (impacts) to near zero.

Output from the Conservation Calculator also cannot quantify the benefits associated with freshwater impacts, including daylighting the on-site stream, which will have long-term beneficial effects. Therefore, the stream daylighting has been included in our effects analysis and those effects are balanced with those determined with the Conservation Calculator.
NMFS has recently found jeopardy on ~65 projects in the nearshore of the Salish Sea. These findings suggest that that original critical habitat designation's exclusion of certain areas from critical habitat for SRKW and Chinook may not adequately reflect the full conservation needs of the species. While the action area is outside of a designation as "critical" habitat, the action area is nearshore habitat within the geographic range of Puget Sound Chinook, Puget Sound steelhead, bocaccio rockfish, and Southern Resident Killer Whales.
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/
REEF (Reef Environmental Education Foundation) –fish and invertebrate survey reports for Solo Point, Saltar's Point Beach, and Sunnyside Beach at https://www.reef.org/db/reports/
Washington Department of Ecology Water Quality Assessment Tool at https://apps.ecology.wa.gov/waterqualityatlas/wqa/proposedassessment
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

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.

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 (IPCC WGI, 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gasses (IPCC WGI, 2021). Globally, 2014-2018 were the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA NCEI 2022). 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 refuges (both flow and temperature) and improving growth opportunity 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 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. 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, interannual 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 uneven. 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.

As cited in Siegel and Crozier (2019), 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. 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% 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.

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 (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 streamflows) 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 intergravel 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 ESUs or DPSs 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 refuges 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 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 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 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 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

Table 1, below provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Multiple Population Grouping), NWFSC (Northwest Fisheries Science Center), TRT (Technical Recovery Team), and VSP (Viable Salmonid Population).

Table 1. 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 2006	NMFS 2016; Ford 2022	This ESU comprises 22 populations distributed over five geographic areas. All Puget Sound 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 Puget Sound 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 2016; 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 Puget Sound 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. In fact, all summer-run steelhead populations in the Northern Cascades MPG are likely at a very high demographic risk.	● 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 ● Dikes, hardening of banks with riprap, and channelization

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Southern resident killer whale	Endangered 11/18/05	NMFS 2008	NMFS 2022k	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

2.3. Environmental Baseline

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

This project would occur on in the nearshore PS and riparian area of the South-Central Basin of the PS on the east "bank" of the sound near Ketron island, about 15 miles south of Commencement Bay and 5 miles north of the mouth of the Nisqually River. The action area is defined by Solo Point itself waterward of the Burlington Northern rail line, the area of construction impacts, and a 500-foot radial area of the aquatic environment which is likely to have measurable contaminants from stormwater discharge from the 1.5-acre parking area. Details about the baseline conditions within the action area are below.

Previous Consultations

In 2016, the Army consulted with NMFS on proposed ongoing military access to marine waters for amphibious training operations for humanitarian aid and disaster response. NMFS issued a letter of concurrence for the proposed action (WCRO-2016-4282). Therefore, military exercises and training at Solo Point, including motorized boat and vehicle use at Solo Point were not included in this consultation.

Physical and Biological Characteristics of the Action Area

Solo point is a 2-acre spit of land jutting waterward from the Burlington Northern Santa Fe (BNSF) railway into the South Salish Sea (Cormorant Passage). Though historically an active delta with a perennial stream confluence, the historic estuary was infilled to become much larger by the military in the past. The date of Solo Point's creation regarding infill for the military is unclear, but may have been in the 1930s.

Solo Point currently has sparse vegetation along with a few patches with some trees, invasive blackberry, and invasive Scotch broom. The BNSF has a tall rip-rap wall associated with the tracks, functionally isolating the nearshore from the uplands at Solo Point and for miles all along the south Salish Sea.

Upland of Solo Point and landward of the BNSF railway is a forested hill. An access road descends from the bluff down to the point. A perennial stream still flows down the hill, adjacent to the road, down a concrete "flue", under the BNSF railway, through a culvert, and out to the Sound at the center of the point. The stream culvert and other infrastructure currently blocks about 1,158 feet of potential anadromous fish habitat that could support juvenile salmonids based

on WDFW criteria of a 2-foot-wide wetted width and grade of 16% or less (Pers. Comm. Darrin Masters, WDFW).

The confluence with the unnamed stream running under Solo Point with the Salish Sea is an important feature of the site. Though the culvert and other infrastructure block fish passage, water flowing down from this stream creates a unique estuarine transitional habitat that is likely a thermal refuge for aquatic species, including listed salmonids, in the summer. This increases the relative value of the nearshore habitat at Solo Point.

Water Quality: Active 303(d)/305(b) water quality listings at this site include a Category 5 listing for enterococci bacteria (370 #col/100ml, sampling year, 2015) and a Category 1 listing for water temperature exceeding 13 degrees Celsius (Ecology 2023).

Waters adjacent to Solo point are part of the Nisqually Reach Aquatic Reserve. The Reserve is state-owned aquatic land, managed by the Washington Department of Natural Resources. The waters in the reserve have a designated use by the Washington Department of Ecology.

Aquatic Life – Extraordinary Quality.
In June, 2016 USACE staff conducted a qualitative kayak and walking survey for marine vegetation at Solo Point. Marine vegetation surrounded the lower third of the boat ramps and consisted primarily of sea lettuce (*Ulva* spp.). Immediately beyond the boat ramps a mixture of algal species and understory kelps were observed including sea lettuce, sugar kelp (*Laminaria* spp.), and red algae (*Gracilaria* spp.). Turkish towel (*Chondracanthus* spp.) was also observe in low density. Plumose anemones (*Metridium senile*) were noted within this marine vegetation (see Figure 6 below). (*Zostrea marina*) was noted 154 feet (47 meters) northwest of the boat ramps and also near the outlet of the stream (see Figure 7 below).

Figure 7. Photograph from June 7, 2016 ACOE qualitative submerged vegetation survey at Solo Point. Sea lettuce, sugar kelp, gracilaria, and plumose algae are visible waterward of the boat ramps.

Figure 2.

Figure 8. Aerial photo with mapped areas of marine vegetation qualitatively surveyed via walking and kayak June of 2016.

The substrate surrounding the boat ramps at the time of the survey consists of sand/silt with a smaller fraction of cobble/gravel and is potentially suitable for sand lance spawning. The substrate surrounding the boat ramps consisted of sand/silt with a smaller fraction of cobble/gravel. At the time of the survey, Solo Point was mostly devoid of wood on the beach and riparian vegetation with the exceptions of the north and south sides of the point that have some trees.

The nearshore at Solo Point has suitable surf spawning habitat. A forage fish spawning survey conducted in 2018 which found eggs at the site (WADNR 2023). Herring may spawn on the macroalgae around the lower elevations of the boat ramps.

Reef Environmental Education Foundation (REEF) SCUBA surveys have been conducted between 1993 and 2023 at the two nearest survey locations, Sunnyside Beach (4 miles north, 266 surveys total) and Saltar's Point (2 miles north, 8 surveys total). Both sites have multiple species of rockfish present, including unidentified larval rockfish, but no ESA listed rockfish were identified. A single REEF survey has been conducted at Solo Point by a novice level diver and six species of invertebrates were identified including the sunflower seastar (REEF 2023).

Listed Species' Presence

PS steelhead – Steelhead that have the potential to occur in the action area originate from two demographically independent populations (DIPs) in the Central and South Puget Sound major population group (MPG) - the South Puget Sound Tributaries DIP, and the Nisqually DIP. They are both winter runs (Ford 2022). Steelhead are present in the Nisqually river, McAllister Creek (Nisqually DIP), and Chambers Creek (South Puget Sound Tributaries DIP). Population abundance data was not available for natural origin steelhead the South Puget Sound Tributaries DIP, including McAllister (5 miles southwest of Solo Point) and Chambers Creek (4 miles north). It is assumed that these populations persist, but their numbers are likely very low. A hatchery steelhead program still exists on Chambers Creek. Total abundance for the total Central and South Puget Sound MPG is in the low thousands of fish (Ford 2022).

Nisqually steelhead had a mean number of natural-origin spawners of 1,368 from 2015-2019. This was the highest amount since the 1990-94 mean. Overall Central and South Puget Sound MPG of steelhead has exhibited a strongly positive increase in five-year abundance. However, the NMFS species recovery plan for steelhead (202x) calls for a 20,000 fish run and currently populations are at less than 10% of their recovery goal. Nisqually and McAllister juvenile steelhead likely migrate past Solo Point during their out-migration. It is entirely possible that other steelhead populations from South Puget Sound Tributaries migrate past Solo Point, as well. Adults migrating to and from the Nisqually would migrate past Solo Point between January-June while smolts would migrate north past the site in April-June. Steelhead do not make extensive use of shallow water habitat in Puget Sound, though are affected by conditions in the water, including stormwater contaminants. Steelhead migrate offshore quickly after exiting their natal stream and are not known to enter small bays and inlets along the shoreline during their migration to the open ocean (Goetz et al 2014).

PS Chinook – Solo Point is in the Central/South Sound (MPGs) for PS Chinook. The two significant populations are from the Nisqually River (approx. 5 miles south) and the Puyallup

River (approx. 15 miles north). Chambers Creek (approx. 4 miles north) also has "Potential" Chinook presence, according to SalmonScape (WDFW 2022). Because some data suggest that up to 70 percent of PS Chinook stay within the Salish Sea and do not migrate to the ocean (Kagley et al. 2016) and because of extensive use of the nearshore by Chinook, we have examined both these nearest Chinook populations. Chinook presence within the action area is likely.

The Nisqually River Chinook run is dominated by hatchery returns with a suppression of natural origin fish. Overall the estimated mean number of natural-origin spawning adults has lingered at around 600 since the 1990s with a larger portion of wild-spawning adults being consistently of hatchery origin (Ford 2022). Nisqually juvenile Chinook likely use the nearshore habitat at and around Solo Point.

The Puyallup River Chinook run is also dominated by hatchery returns, which have exceeded mean natural origin fish since the 1990s. Estimated mean number of natural-origin spawners has fallen from the low 2000s in the 1990s to around 500 since 2010. A small increase was seen in the 2015-2019 data, with natural origin spawners rising from an estimated mean of 450 to 577.

SRKW - Despite seasonal patterns, SRKW individuals can occur throughout their range at any time of the year. The Whale Museum and NMFS manage a long-term database of SRKW sightings and geospatial locations. Reported sightings are assigned to 1 of 445 quadrants (~4.6 km x 4.6 km). Numbers indicate the total number of unique sightings in each quadrant. Solo Point is located in quadrant 427 (which includes the Nisqually confluence). NMFS sighting data indicates a total of 5 sightings of SRKW for quadrant 427 from 1990 to 2013 SRKWs are most likely to be in the area during December and January.

Given the limited number of sightings, it is unlikely that SRKWs would be physically present in the action area during construction. The intertidal and shallow intertidal marine area where the work will take place is also shallow for SRKW. Chinook and chum, SRKW's most common prey species in the Puget Sound (Hanson 2021), use these shallow nearshore environments. The survival of SRKWs has been shown to positively correlate with Chinook salmon abundance (Ford 2010).

2.4. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (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).

There is an array of long-term effects that degrade habitat quality associated with the Solo Point proposed action. There are also several proposed elements that will improve long term habitat quality. These proposed actions have individual level consequences for ESA listed species.

Effects on species are a function of exposure and response to the effects listed above. The degree of exposure (duration and intensity) will influence response, as will the specific species, life stage, and underlying health of the individuals exposed. Individuals of the listed species will have exposure to both long- and short-term effects in their habitat. Construction would occur during one season/work window between July 15 and February 15, unless further restricted due to forage fish or herring presence. Once constructed, the structures at Solo Point would be expected to remain in the aquatic environment for their useful life (expected to be 50 years for the purpose of this analysis). Thus, multiple individuals from successive cohorts of the multiple populations of PS Chinook salmon, PS steelhead, and SRKW are likely to be exposed to the habitat effects associated with the proposed action.

Habitat effects include 1) reduce water quality from turbidity and reduced dissolved oxygen during site disturbance; 2) reduced aquatic vegetation and elimination of nearshore intertidal habitat including substrate from the structure; 3) elimination of intertidal habitat by structures 4) increased scour waterward of shoreline armoring from the structure; 5) increased spawning substrate in intertidal and decreased beach physical disturbance; 6) decreased pollution from improved stormwater treatment (compared to current conditions); 7) decreased turbidity by the elimination of vehicular access from the intertidal area; 8) improved water temperature, cover, and detrital prey inputs from riparian plantings; and 9) increased habitat area due to removal of the extant culvert 1 and stream habitat restoration.

The effect pathways above can be presented as influencing three significant habitat components: water quality; forage; and area of accessible habitat.

Water quality

Water quality will be degraded by increased suspended sediment and reduced DO during construction (LaSalle 1988). Elevated turbidity often causes juvenile salmon to leave an area, thereby eliminating forage opportunities and exposing them to increased predation (Servizi and Martens 1992; Newcombe and Jenson 1996). If caught in a turbidity plume, fish can experience coughing, gill abrasion, and death (Newcombe and Jenson 1996). NMFS expects that construction will follow Washington Code (WAC-173-201A-400) and a 200-foot mixing zone from the point of disturbance will not be exceeded. Marine riparian areas are important for many factors tied to water quality including fine sediment control; stormwater filtration; shade (temperature); heathy hydrology and slope stability (WDFW 2009b). The long-term riparian plantings along the soft shore armoring could provide improved water quality through increased stormwater filtration and less scour from storm events. Riparian plantings adjacent to the new stream channel (in place of culvert 1) will provide shade, reducing water temperature, as well as the benefits listed above. Eliminating vehicular access to the intertidal would also reduce turbidity and improve water quality.

A myriad of substances harmful to aquatic life can be found in road runoff from vehicles including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), heavy metals, fuel, oils, brake fluids, de-icing agents, salts, microplastics, particulate matter, and the recently identified 6ppd (Sutton et al. 2019; Buckler and Granato 1999; Colman et al. 2001; Driscoll et al. 1990). The Ecology BMP T9.40 Vegetative Filter Strip will provide “basic level” treatment, per Ecology (2019). The boulders preventing vehicle access to the beach would

reduce direct, unfiltered input of toxic substances. But, listed species within the action area would still experience some water quality impacts associated with stormwater runoff from the site. Though Solo Point is not heavily trafficked, because it is used as a boat launch and parking area, pollutants in runoff are likely at a lower concentration than areas of high use, but still contribute harmful substances in stormwater proportional to the area's size and use (Kayahanian et al. 2003).

Following installation of the treatment, the water surrounding the point will have a relatively static amount of contaminant for the foreseeable future with the continued use of the site as a boat ramp and parking lot. Site runoff will have a commensurate addition of treatment that would remove some contaminants. PS Chinook salmon, PS resident Chinook (non-migrants), and any other out or in-migrating Chinook in the action area would be affected by runoff from the site. Steelhead would also be affected during migration. Either species would be affected if they use the new stream on site. Salmonids experience adverse effects from exposure to stormwater including decreased growth, immune response, mobility, fecundity, and reaction time. Exposure can also cause death. Juvenile salmonids are more susceptible to toxicity effects than adults. (Feist et al. 2011; Johnson et al. 2007; Loge et al. 2006; Sandahl et al. 2007, and Spromberg and Meador 2006). Contaminants from runoff can even have additive and synergistic effects that exceed the contaminants themselves (Kagawa 2002) Juveniles are also more likely to use the nearshore environment within 500 feet of Solo Point. 6ppd/6ppdq has been shown to be lethal to both juvenile steelhead and Chinook, though steelhead are much more susceptible to it than Chinook, both can be killed with relatively small concentrations of this substance from tire particles. SRKW will experience some minor trophic effects of runoff (Braig et al. 2021; Harris et al. 2011) through harm to PS Chinook, their main food source and one of SRKW physical and biological features of SRKW critical habitat. The proposed vegetative filter strip will greatly reduce contaminants discharged into Puget Sound. Biofiltration has been shown to greatly reduce 6ppd concentrations and effects to salmonids (Ecology 2022). We believe that the risks associated with exposure to contaminants from the parking area, while not avoided, would be minimized as a result of this action.

Prey/Forage

Prey items, aka food or forage, will decrease where the expanded footprint of the concrete boat ramp is constructed, and in immediately adjacent areas where boat motors cause propeller wash, and refracted wave energy causes scour. These will continually disturb sediments and eliminate plants that would otherwise harbor and support prey species (Bilkovic and Roggero 2008; Fresh et al. 2011; Morley et al. 2012; Dethier et al. 2016; Patrick et al. 2014; Rice 2006; Shipman et al. 2010; Parks et al. 2013). Actions that eliminate prey species decrease relative fitness and success of PS Chinook. Because Chinook are the preferred prey species to SRKWS, we expect that this reduction in prey and fitness will negatively impact orcas through the trophic connection of reduced prey items (Hanson et al. 2021). Vehicles driving in the intertidal of Solo Point currently suppress forage by directly crushing/disrupting invertebrates and eliminating intertidal vegetation (Schlacher and Thompson 2007). When vehicular access is restricted by boulder placement, we expect sediment and aquatic vegetation conditions to improve. Reduced disturbance would support increased prey species without reoccurring vehicular disturbance (Dernie et al 2003). Finally, as riparian vegetation plantings mature, detrital prey input should increase. And elimination of the fish passage barrier will introduce new areas for foraging and

greater invertebrates both in the stream and via allochthonous inputs (outside sources such as falling from plants). Placement of suitable material as beach nourishment on site may provide temporary beneficial effects to forage fish as spawning substrate (Penttila 2007). This would thereby increase forage fish availability to Chinook. However, a recent synthesis paper (Lambert and Chamberlin 2023) could not find benefits of nourishment waterward of armoring. The effects of nourishment waterward of soft shore/gradual slope armoring are not well studied and could enhance habitat for several years at this blocked feeder bluff before washing away.

Accessible Habitat

The replacement of existing ramps with a one larger boat ramp will degrade and block upper intertidal habitat by eliminating substrate and serving as shoreline armoring. The soft shore armoring around Solo Point will create a steeper slope that eliminates upper intertidal areas to juvenile salmonids during high tides. Barriers to anadromous fish passage are a significant limiting factor for listed salmonids by directly elimination of habitat used spawning, rearing, cover, thermal refugia, and forage (Ford 2022). This project will remove a culvert blocking fish passage on the unnamed perennial stream on site and open up new confluence habitat (estuarine) and open up approximately 1,158 linear feet of small stream freshwater habitat (USGS National Mapp and WAC 22-16-031).

Individuals of listed species in this opinion will be exposed to the long- and short-term effects described above. We summarize the exposure and response for species in Table 2 below:

Table 2. Summary of effects of the action on ESA listed species

Activity/Structure	Habitat Effect	Duration	Affected Area	Species and Life Stage Exposed	Response	Effects
Construction and removal of debris/sediment from ramp	1) Turbidity, site disturbance, reduced dissolved oxygen, and a 2) reduction in aquatic vegetation	Up to 6 months (IWWW)	300 ft	Chinook*	Raised cortisol, cough, gill abrasion and/or site avoidance; possible increased forage (Chinook)	Reduced growth and fitness, increased predation risk, death, increased growth and fitness (due to increased forage) (Chinook)
Installation of shoreline armoring (including softshore armoring and riprap at culverts) and boat ramp	3). Elimination of nearshore intertidal habitat including substrate and 2) vegetation. 4) Increased scour waterward of shoreline armoring leading to decreased aquatic vegetation	50 years	380 lf soft armoring, 5656 sqft concrete ramp, 20 ft scour waterward of armoring	Chinook, SRKW through Chinook	1 Inability to access nearshore habitat behind armoring, decreased nearshore use due to concrete ramp (Chinook, rockfish) 2. Decreased site use due to decreased aquatic vegetation (Chinook, rockfish)	Reduced forage (Chinook, SRKW), reduced cover (Chinook), increased predation risk (Chinook)
Placement of beach nourishment	5) Increased spawning substrate in intertidal	5 years (estimated)	262 cy	Chinook, SRKW through Chinook	Increased prey density (Chinook), increased prey density through Chinook pathway (SRKW)	Increased growth and fitness (Chinook and SRKW)
Installation of vegetative filter strip (Ecology BMP T9.40)	6)Stormwater treatment around the designated parking area	50 years	Area of discharge detection from 1.5 acres of PGIS.	Steelhead (migrating juv and adults), Chinook (juv, adults, resident), SRKW, SRKW through Chinook	Sublethal response due to continued trace pollutants (all species), increased site use (Chinook and rockfish), and decreased exposure to contaminants compared to current condition (all species)	Overall increased fitness and survival, increased forage (all species), some decreased chronic fitness due to persistent pollutants from PGIS.
Installation of boulders and designated pedestrian access areas	7) Decreased beach physical disturbance, decreased pollution, and decreased turbidity by the elimination of vehicular access	50 years	Prevent access to 1.5 acres of intertidal. Effects up to 1 km away.	Chinook, steelhead, SRKW through Chinook	Increased site use (Chinook and rockfish), increased feeding due to increased forage species (Chinook), decreased exposure to contaminants (Chinook, rockfish, steelhead)	Increased fitness and survival (all species), increased forage (Chinook)

Activity/Structure	Habitat Effect	Duration	Affected Area	Species and Life Stage Exposed	Response	Effects
Invasive plant removal, herbaceous native plantings, woody debris accrual and installation	8) Improved water quality (temperature), cover, and detrital prey inputs	50 years	12,800 sqft	Chinook, steelhead, SRKW through Chinook	Increased site use, increased forage species, decreased exposure to contaminants through bio-filtration	Increased forage (Chinook, SRKW), increased cover (Chinook), increased fitness and survival (all species)
Restore/daylight stream from the Burlington Northern rail line to the Puget Sound	9) Eliminate fish passage barrier and increase accessible habitat.	In perpetuity	1,158 feet of potential stream habitat	Chinook (juv), steelhead (adult and juv), SRKW through Chinook	Increased fitness through increased spawning habitat (steelhead adults), expanded juvenile refugia and rearing areas (steelhead and Chinook juvs), and increased fitness to SRKW through increased survival of Chinook.	Increased fitness through increased potential spawning habitat (steelhead adults), expanded juvenile refugia and rearing areas (steelhead and Chinook juvs), and increased fitness to SRKW through increased survival of Chinook.
*Adherence to the IWWW for construction will minimize the likelihood of juvenile Chinook presence. However, juveniles have been found in PS neritic waters between April and November (Rice et al 2011) and up to 70% percent of Chinook juveniles do not out-migrate to the ocean (Kagley et al. 2016) and could be present as sub-adults in the action area.						

2.4.1 Effects on Habitat

A critical habitat analysis was not included in this biological opinion due to JBLMs current INRMP. However, many habitat features will be modified either temporarily or over the long term.

2.5. Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area, such as recreational boating. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.4). We expect many of the previously described climate effects to intensify over the life of the project.

Solo Point and its surrounding waters are used for recreation. Effects to ESA listed species associated with recreational activities include increased noise, turbidity, and physical disturbance caused by boating, fishing, and other human presence/activities. Recreational activities have the potential to cause cumulative effects when combined with the proposed action, including the construction-related disturbances and the increased boat activity that may follow.

Though areas surrounding JBLM have experienced population increases in recent decades, NMFS expects that land-use and intensity on the military base will remain relatively constant throughout the design/impact life of the proposed action.

2.6. 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 (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution.

The status of each ESA species considered in this opinion is threatened, except for SRKW, which are endangered. The status of all species is based on low abundance relative to historic numbers, with reduced productivity, spatial structure, and diversity. This depressed condition is a function of many factors, including reductions in the amount or quality of habitat throughout

their range, and overharvest in previous years. Baseline conditions in the action area, which were described earlier in this document, reflect habitat degradation typical in the near-marine environment.

PS Chinook salmon have a moderate risk of extinction (Ford 2022) Identified limiting factors to recovery include: 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; and severely altered flow regime. The Nisqually and Puyallup populations continue to be depressed with natural origin runs of about 600 total adults each since 1900s. Threats include high hatchery production and habitat degradation (Ford 2022). No population data was available for the South Puget Sound Tributaries DIP, which is one of the DIPs that would be affected by the action.

PS steelhead also have a moderate risk of extinction (Ford 2022). Identified limiting factors to recovery include continued destruction and adverse modification of habitat, widespread declines in adult abundance, and threats to diversity from hatchery steelhead stock. Nisqually steelhead had a mean number of natural-origin spawners of 1,368 from 2015-2019. This was the highest amount since the 1990-94 mean. Population data for McAllister and Chambers Creek was not available and additional populations of steelhead likely migrate past Solo Point.

SRKW have a high risk of extinction (NMFS 2022) with limiting factors to recovery including quantity and quality of prey, exposure to toxic chemicals, disturbance from sound and vessels, and risk from oil spills.

A factor for decline that all these species share is degradation of habitat. Human development in the Pacific Northwest has caused significant negative changes to stream and estuary habitat across the range of these species. The baseline in the action area reflects anthropogenic degradation similar to many locations in Puget Sound.

To this status and baseline, we add the effects of the proposed action as described earlier in this document. While construction effects are temporally constrained, with a limited exposure or response among the listed species, some effects are enduring.

The proposed action's discharge would create a chronic area of exposure to stormwater for PS Chinook salmon, PS steelhead, occasional direct exposure of SRKW, and occasional exposure of SRKW through Chinook as a food source. Contaminants in this discharge are likely to produce a range of adverse health effects among exposed juvenile salmonids. However, it is important to note that the discharge from the parking area at Solo Point would be treated to Ecology's "basic" level, the purpose of which is to capture and improve the treatment of currently minimally treated stormwater to reduce contaminants prior to discharge. For this reason, we expect health consequences associated with this aspect of the proposed action are likely to occur at a lower rate than at the baseline (pre-project) level for the parking lot runoff. Because PS Chinook exposed to stormwater are also prey species of SRKW and this prey level is not appreciably reduced, we consider that the effects on SRKW are limited to the occasional exposure to stormwater, and that responses of SKRW are likely to be at a level that produces only latent and sublethal responses.

Similarly, structures proposed would negatively impact some individuals of the listed salmonid species from many cohorts for estimated 50-year life of the structures via the boat ramp, and the shoreline armoring. Several other project elements would produce positive species-level effects by providing improved conditions that the same cohorts would experience, such as daylighting the stream, riparian plantings, stormwater treatment (compared to current conditions), and debris removal. Daylighting the stream will result in enduring long-term benefits for PS steelhead and PS Chinook by removing a barrier to fish passage and restoring previously eliminated confluence habitat.

When considered together, the salmonid species exposure and response contain both negative and positive aspects, and overall, we do not anticipate a long-term decline, or gain, in population abundance or productivity, but expect relatively static population dynamics due to this projects' balance of effects.

To frame the impacts in another way, the Conservation Calculator output for the Solo Point project is -155 based on an assumption within the Calculator itself that riparian plantings have a relatively low success rate over time. However, the extant JBLM ESMP for salmonids focuses on the maintenance of riparian buffers, invasive removal, and native plantings adjacent to freshwater streams. Due to JBLM Directorate of Public Works Environmental Division's commitment to maintain and protect riparian areas through this ECMP, the rockfish ECMP, and their active INRMP, plantings are expected to be maintained for survival and reach their full habitat potential on site. Accordingly, this would adjust the habitat value associated with those plantings. This adjustment, while not reflected in the numeric calculator output, would bring overall long-term habitat impacts (as quantified in the calculator) to near zero. Water quality impacts and freshwater impacts (stream restoration) were not quantified in the calculator. The new stream confluence will create a large habitat lift at this site for salmonids and stormwater treatment installed will reduce, but not eliminate, species impacts within the action area. This aspect of reduced degradation is factored in our analysis of effects over the life of the project.

Cumulative effects, including climate change are likely to increase, and exacerbate several of the ongoing habitat issues, in particular, increased summer temperatures, and decreased summer flows in the freshwater environment, ocean acidification, and sea level rise in the marine environment. When cumulative effects are considered, the addition of the project effects are not sufficient to impede survival or recovery of the listed fish species.

2.7. Conclusion

After reviewing and analyzing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook, PS steelhead, or SRKW.

2.8. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is

defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "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 ITS.

2.9.1 Amount or Extent of Take

When take is in the form of harm from habitat degradation, it is often impossible to enumerate the take that would occur because the number of fish and marine mammals likely to be exposed to harmful habitat conditions is highly variable over time, influenced by environmental conditions that do not have a reliably predictable pattern, and the individuals exposed may not all respond in the same manner or degree. Where NMFS cannot quantify take in terms of numbers of affected individuals, we instead consider the likely extent of changes in habitat quantity and quality to indicate the extent of take as surrogates. The best available indicators for the extent of take, proposed actions are as follows.

NMFS has determined that incidental take is reasonably certain to occur in Table 3 below:

Table 3. Incidental take pathways and associated indicators in the amount or extent thereof.

Incidental Take Pathway	Amount or Extent of Incidental Take
Harm to Chinook caused by **in-water construction and continued sediment/debris removal.**	An area of increased turbidity not to exceed 300 feet from the point of sediment disturbance.
Harm to Chinook, and SRKW through Chinook caused by **eliminated intertidal habitat and increased scour waterward of armoring.**	Not to exceed 380 linear feet of soft armoring and 5656 square feet of boat ramp.
Harm to steelhead, Chinook, and SRKW caused by **stormwater input from PGIS**	Treated discharge from a maximum of 1.5 acres of PGIS.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. Minimize incidental take associated with construction

2. Reduce take from riparian disturbance by ensuring the long-term success and habitat functionality of the proposed stream restoration and the riparian plantings.

3. Reduce take from water quality reductions by ensuring the continued function and effectiveness of the stormwater treatment on site.

4. Monitor effects to ensure take does not exceed that described in this consultation.

2.9.4 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.

The following terms and conditions implement the reasonable and prudent measures:

1. Minimize incidental take associated with construction:
    a. Stage/store large, mechanized construction equipment off of Solo Point or create a leak-proof staging area on the Point that has absorptive material or similar.
    b. Follow the forage fish window as specified in WAC 220-660-330 – or request a WDFW-trained biologist to conduct an approved intertidal forage fish spawning survey to approve potential work outside the forage fish work window per WAC 220-660-340. Construction may occur in the forage fish window if no evidence of forage fish spawning is found.
    c. Do not place beach nourishment on or directly updrift of areas with attached aquatic vegetation with density over 10%.
    d. Conduct turbidity monitoring on site and ensure that:
        i. Visual turbidity does not exceed a 300 ft radius from construction.
        ii. Turbidity at 300 ft does not exceed 5 nephelometric turbidity units (NTUs) more than background turbidity when the background turbidity is 50 NTUs or less, or a 10 percent increase in turbidity when the background turbidity is more than 50 NTUs.
        iii. Halt construction and wait for turbidity to subside before resuming if i or ii are triggered.

e. Allow cast-in-place concrete to cure for a minimum of 7 days (via dewatering or simply above the tide), or, if not feasible, replace cast-in-place sections with pre-cast concrete slabs.

2. Reduce take from riparian disturbance by ensuring the long-term success and habitat functionality of the proposed stream restoration and the riparian plantings.
    a. Follow WDFW Stream Habitat Restoration Guidelines (Cramer 2012) Technique 4 (Channel Modification) Section 5 (Methods and Design) to ensure successful channel restoration.
    b. Water planted areas once a week during the first dry season (if rain has not occurred) following planting and every other week the next year's dry season.
    c. Replant areas that fail and maintain at least an 80% plant survival at 5 years from construction.
    d. Incorporate different vegetation types into the planting plan to include 20% of area as native trees and 20% as native shrubs. Percent area is determined by mature plant sizes (not overall coverage at time of planting).

3. Reduce take from water quality reductions by ensuring the continued function and effectiveness of the stormwater treatment on site.
    a. Inspect and maintain the vegetative filter strip stormwater treatment (Ecology BMP T9.40) to the filtration specifications outlined in the Washington Stormwater Treatment Design Manual.
    b. If repair or replacement of the stormwater treatment system is needed, an equivalent or more robust treatment system shall be installed.

4. Monitor effects to ensure take does not exceed that described in this consultation.
    a. The Army shall provide reports to projectreports.wcr@noaa.gov within 60 days of project completion
    b. The report shall include "as-built" documentation and site photos following construction to confirm constructed elements.
    c. 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".
    d. Any corrective measures taken to reduce turbidity levels, achieve stormwater compliance, or ensure planting survival.

2.9. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, "conservation recommendations" are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. Because the active INRMP and ECMPs for Joint Base Louis McCord include very few provisions for resource management for listed salmonids in the nearshore, we recommend

that the Army update these documents to include more robust nearshore protections that adequately address critical habitat for NMFS' listed ESA species.

   a. Incorporate nearshore habitat conservation and preservation measures into the current active salmonid ECMP.
   b. Update and finalize an ECMP for listed bocaccio and yelloweye rockfish that includes actionable steps to protect and enhance nearshore submerged aquatic vegetation, particularly kelp species (as far as NMFS is aware, there is only a 2013-2018 draft).

2. Partner with REEF to document offshore fish, aquatic invertebrates, and aquatic vegetation (including algae) at Solo Point. – and track presence and abundance of the sunflower seastar (*Pycnopodia helioanthoide*) at this location, which is currently proposed for listing under the ESA and has historically been sighted at this location and nearby REEF survey locations.
3. Inventory and prioritize replacement of fish passage barriers on JBLM property, including those that intersect with the Burlington Northern Railway.
4. Coordinate with Burlington Northern Railway and WDFW to enhance nearshore habitat and remove barriers to fish passage along the railway adjacent to JBLM.
5. Send members of JBLM's Public Works Environmental Division staff to WDFW's available Fish Passage Training.
6. Create an invasive species management plan and schedule for Solo Point.
7.

2.10. Reinitiation of Consultation

This concludes formal ESA consultation for the Joint Base Lewis McChord Solo Point Boat Ramp, Culvert Replacement, and Shoreline Stabilization.

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."

2.11. "Not Likely to Adversely Affect" Determinations

Reef Environmental Education Foundation (REEF) surveys conducted between 1993 and 2023 at the two nearest survey locations, Sunnyside Beach (4 miles north, 266 surveys total) and Saltar's Point (2 miles north, 8 surveys total). Both sites have multiple species of rockfish present, including unidentified larval rockfish, but no ESA listed rockfish were identified. (Reef 2003)

PS/GB Bocaccio:
PS/BG bocaccio have been found in low numbers associated with nearshore environments as juveniles by WDFW during their surveys across the PS. However, there has been no documented

presence of bocaccio adults or juveniles in the South Puget Sound (WDFW 2009). Overall estimated contribution of bocaccio to total rockfish species composition in the South PS was 0%. Bocaccio averaged 0.2% of rockfish catch in South Sound during the 1980s, but has not been encountered in South Sound after 1996. Though bocaccio larvae drift with currents and are often associated with drift algae, it is unlikely that larvae would drift to Solo Point action area with the highly depressed population. Therefore, NMFS considers possible effects to adult and juvenile bocaccio rockfish discountable due to lack of presence at nearby REEF survey locations and, more broadly, in the South Puget Sound during the 2009 WDFW survey.
PS/GB Yelloweye:

Video abundance estimates for Yellowtail in the south PS for 2001-2002 were 10,087 individuals (SE of 98.5%) and total rockfish biomass estimates for yelloweye in the South PS for 2005 were 0.5%). The nearest yelloweye found during the 2009 survey were near South Seattle (WDFW 2009). In general, observations of these species in PS are rare (NMFS 2014). Therefore, NMFS considers possible effects to adult and juvenile yelloweye rockfish discountable due to lack of presence at nearby REEF survey locations and, more broadly, south of South Seattle.

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 conducted by the consulting biologist and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council (PFMC 2005), coastal pelagic species (CPS) (PFMC 1998), Pacific Coast salmon (PFMC 2014); and highly migratory species (HMS) (PFMC 2007) 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 nearshore affected by the proposed action is Essential Fish Habitat (EFH) for Groundfish, Coastal Pelagic species (finfish and krill), and Coastal Pacific Salmon (pink, Chinook, and coho).

The proposed action and action area for this consultation are described in Section 1 of this document. Solo point itself is a bare gravel point with sparse vegetation. However, in the Puget Sound immediately surrounding Solo Point there is eelgrass and dense aquatic vegetation including kelp (not canopy forming). A perennial stream confluence, draining through a culvert, is also in the center of Solo Point. The Coastal Atlas map (Ecology) displays Kelp – fringe (patchy) and Eelgrass – fringe (patchy) at the Solo Point site and on-site surveys confirmed a diverse array of invertebrates and aquatic vegetation.

The action area includes Essential Fish Habitat for 1) Coastal Pacific Salmon (pink, Chinook, and coho) 2) Coastal Pelagic Species (finfish and krill) and 3) Groundfish. The PFMC described and identified EFH for Pacific coast groundfish (PFMC 2005), Pacific salmon (PFMC 2014), and coastal pelagic species (PFMC 1998).

Habitat Areas of Particular Concern (HAPCs) identified for groundfish within the action area are **estuary, habitat associated with canopy-forming kelp, rocky reefs, and seagrasses.** HAPCs for salmon associated with the action area are **thermal refugia, spawning habitat, estuaries, and submerged aquatic vegetation.** There are no designated HAPCs for coastal pelagic fishes. See section 2.3 above in the ESA consultation for detailed information regarding the habitat currently present. See the baseline section in the ESA portion above for an overview of the habitat currently present at Point Hudson and the results from the 2016 qualitative habitat survey conducted on by USACE.

EFH species presence

Solo Point is adjacent to the Nisqually Reach Aquatic Reserve which is managed by the Washington Department of Natural Resources for its high value habitat for both juvenile salmon and pacific sand lance (as well as pigeon guillemonts). Animals regularly seen migrating, feeding, or resting through the Reach include a variety of jellyfish, forage fish, squid, and marine mammals including killer whales. Salmonids in the Nisqually river basin (that could use the action area for HAPCs listed above) include (from most abundant to least abundant), chum, coho, pink, steelhead, Chinook, cutthroat trout (WADNR 2011).

The Nisqually Reach Aquatic Reserve Management Plan, Appendix A, (WADNR 2011) includes an inexhaustive list of species found in and adjacent to the reserve compiled from a variety of sources. We expect similar species to be potentially present within the action area for Solo Point. The following table is a list of the EFH species documented in and adjacent to the Aquatic Reserve.

Table 4. EFH species documented within the Nisqually Reach Aquatic Reserve – potentially using habitat within the proposed action area.

Species	EFH Fishery
Chinook Salmon *Oncorhynchus tshawytscha*	Pacific Salmon
Coho Salmon *Oncorhynchus kisutch*	Pacific Salmon
Pink Salmon *Oncorhynchus gorbuscha*	Pacific Salmon
California Market Squid *Loligo opalescens*	Coastal Pelagic
Northern Anchovy *Engraulis mordax*	Coastal Pelagic
Arrowtooth Flounder *Atheresthes stomias*	Groundfish
Brown Rockfish *Sebastes auriculatus*	Groundfish
Big Skate *Raja binoculata*	Groundfish
Butter Sole *Isopsetta isolepis*	Groundfish
Cabezon *Scorpaenichthys marmoratus*	Groundfish
Copper Rockfish *Sebastes caurinus*	Groundfish
Dover Sole *Microstomus pacificus*	Groundfish
Pacific Sanddab *Citharichthys sordidus*	Groundfish
Petrale Sole *Eopsetta jordani*	Groundfish
Quillback Rockfish *Sebastes maliger*	Groundfish
Spotted Ratfish *Hydrolagus colliei*	Groundfish
Redstripe Rockfish *Sebastes proriger*	Groundfish
Rex Sole *Glyptocephalus zachirus*	Groundfish
Southern Rock Sole *Lepidopsetta bilineata*	Groundfish
Sablefish *Anoplopoma fimbria*	Groundfish
Sand Sole Psettichthys melanostictus	Groundfish
Sharpchin Rockfish *Sebastes zacentrus*	Groundfish
English Sole *Parophrys vetulus*	Groundfish
Flathead Sole *Hippoglossoides elassodon*	Groundfish
Pacific Hake *Merluccius productus*	Groundfish
Kelp Greenling *Hexagrammos decagrammus*	Groundfish
Lingcod *Ophiodon elongatus*	Groundfish
Longnose Skate *Raja rhina*	Groundfish
Pacific Cod *Gadus macrocephalus*	Groundfish
Spiny Dogfish *Squalus acanthias*	Groundfish
Starry Flounder *Platichthys stellatus*	Groundfish

Reef Environmental Education Foundation (REEF) surveys conducted between 1993 and 2023 at the two nearest survey locations, Sunnyside Beach (4 miles north, 266 surveys total) and Saltar's Point (2 miles north, 8 surveys total). Both sites have multiple species of rockfish present, including unidentified larval rockfish. A single REEF survey has been conducted at Solo Point by a novice level diver and six species of invertebrates were identified including the sunflower seastar (REEF 2023).

The following *additional* EFH species (not identified in the Nisqually Reach data above) and HAPC habitat indicators have been identified at the nearest REEF survey locations and likely occur within the action area of Solo Point: Black Rockfish (*Sebates melanops*), Bull Kelp (*Nereocystis luetkeana*) – **HAPC (for groundfish) canopy forming kelp**, Kelp Greenling (*Hexagrammos decagrammus*), Pacific Sanddab (*Citharichthys sordidus*), Quillback Rockfish, (*Sebastes maliger*), Yellowtail Rockfish YOY (*Sebastes flavidus*).

3.2. Adverse Effects on Essential Fish Habitat

The project includes both detrimental and beneficial effects on EFH for Pacific Salmon, Groundfish, and Coastal Pelagics. The increase in riparian vegetation on site, daylighting the stream, installation of the vegetative buffer (stormwater treatment), and elimination of vehicular access to the beach will benefit water quality, and prey quality, and directly increase accessible habitat. Detrimental effects of the proposed action are detailed in Section 2 of this document (ESA effects analysis) but reiterated briefly here:

> Specific features of EFH that will be adversely affected include 1) water quality during construction and through stormwater inputs from PGIS, 2) aquatic vegetation during construction, 3) substrate impacts (scour waterward of armoring), and direct elimination of habitat via the boat ramp, and 4) forage base via elimination of habitat due to installation of armoring, a boat ramp.

<u>Effects to HAPCs</u>
Groundfish HAPCs in the action area:

Estuary – All of the Puget Sound is an estuary. Within the Solo Point action area, the confluence of the perennial stream provides another estuarine transitional area where fresh meets salt water. The projects action area and effects discussed in this biological opinion extend into the Puget Sound.

Habitat associated with canopy forming kelp – This includes hard substrates such as rocky reefs and some gravels. Bull kelp have been identified during REEF surveys at Sunnyside beach and could occur within the action area. Scour from the installed soft and hard armoring on site (approx. 400 linear feet) will impact substrates and vegetation waterward of the armoring. Water quality degradation could impact canopy forming kelp in the entire action area.

Rocky reefs – A steep drop off occurs just off of Solo Point which likely has hard substrata. Other indicator groundfish species exist (see below) that associate with rocky reefs. – this area is not likely to be impacted by the project, though water quality degradation could reduce its usability by Groundfish species.

Eelgrass – an eelgrass bed was identified just off Solo Point in the 2016 USACE qualitative habitat survey. Scour from the installed soft and hard armoring on site (approx. 400 linear feet) would impact substrates and vegetation waterward of the armoring, this could include eelgrass. The expanded boat ramp will eliminate substrate in the nearshore that would otherwise support

SAV. Though the documented eelgrass bed is not in the same location as the proposed ramp, eelgrass bed locations change over time.

Salmon HAPCs in the action area:

Thermal refugia: Water from the confluence perennial stream culvert in the center of Solo Point likely provides a thermal refugia for salmon during the summer. Once the stream is daylighted, it would restore over 1000 linear feet of potential thermal refuge, in addition to the already extant confluence.

Spawning habitat: A small amount of low gradient (<3%) habitat exists upstream of the culvert before the gradient increases. It is likely that the only EFH salmon species that would use this area for spawning would be Coho and possible Steelhead. This habitat will continue to be eliminated.

Estuaries – see above.

Submerged aquatic vegetation: Sea lettuce, sugar kelp, gracilaria, and plumose algae were found waterward of the extant boat ramps during the 2016 USACE qualitative survey. Scour from the installed soft and hard armoring on site (approx. 400 linear feet) will impact substrates and vegetation waterward of the armoring. The expanded boat ramp will eliminate substrate in the nearshore that would otherwise support SAV.

The chronic, episodic, and enduring diminishments of EFH created by nearshore structures to water quality, migration areas, shallow water habitat, forage base, and SAV has and will continue to incrementally degrade the function of EFH. Enhanced riparian, fish passage restoration, restoration of a perennial stream channel will create enduring benefits for listed species.

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. Adopt Washington State standards and code for the remediation of fish passage barriers for all of JBLM. Incorporate this language into the Salmonid ESMP.

2. Seek advice from WDFW on all projects with potential fish passage elements.

3. Install signage at Solo Point with rules to protect habitat enhancements. Examples - “Please do not burn, take, or remove driftwood or vegetation from Solo Point – it is fish habitat”, “Do not trample this area of native plantings”

4. Install an educational sign(s) at Solo Point that highlight the habitat improvements that the Army has made at this site and their importance to the ecosystem.

5. Use natural materials to cordon off areas with native plantings for the first 2 years.

6. Remove the concrete chute associated with the perennial stream as part of this project, or within the next 5 years. We recommend removal during summer low flow and before fish passage is restored

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, Pacific Coast groundfish, coastal pelagic species, and U.S. West Coast highly migratory species.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, The Army 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 Army 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 user of this opinion is the United States Department of the Army. Other interested users could include the U.S. Army Corps of Engineers, Washington Department of Fish and Wildlife, and the Nisqually Tribe. Individual copies of this opinion were provided to the Army. 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.

5. REFERENCES

Able, K.W., J.P. Manderson, and A.L. Studholme. 1998. The distribution of shallow water juvenile fishes in an urban estuary: The effects of manmade structures in the lower Hudson River. Estuaries. 21:731-744.

Bilkovic, D.M., and M.M. Roggero. 2008. Effects of coastal development on nearshore estuarine nekton communities. Marine Ecology Progress Series. 358:27-39.

Braig, S., Delisle, K, Noël, M., LeNoble, J., Thompson, H.C. and A.S. Rao. 2021. Water Quality Assessment and Proposed Objectives for Burrard Inlet: Polycyclic Aromatic Hydrocarbons (PAHs) Technical Report. Prepared for Tsleil-Waututh Nation and the Province of B.C.

Brophy LS, Greene CM, Hare VC, Holycross B, Lanier A, et al. 2019. Insights into estuary habitat loss in the western United States using a new method for mapping maximum extent of tidal wetlands. PLOS ONE 14(8): e0218558.

Buckler, D. R., and Granato, G.E., 1999, Assessing biological effects from highway-runoff constituents: U.S. Geological Survey Open-File Report 99-240, 45 p.

Center for Biological Diversity (CBD). 2006. The Puget Sound Basin. Center for Biological Diversity web page. http://www.biologicaldiversity.org/swcbd/ecosystems/pugetsound/index.html. Article dated December 6, 2006. Accessed May 31, 2019.

Colman, J. A., Rice, K.C., and Willoughby, T.C., 2001, Methodology and significance of studies of atmospheric deposition in highway runoff: U.S. Geological Survey Open-File Report 01-259, 63 p.

Cramer, M. L. (managing editor). 2012. Stream Habitat Restoration Guidelines. Copublished by the Washington Departments of Fish and Wildlife, Natural Resources, Transportation and Ecology, Washington State Recreation and Conservation Office, Puget Sound Partnership, and the U.S. Fish and Wildlife Service. Olympia, Washington.

Dernie, K. M., M.J. Kaiser, E.A. Richardson, and R.M. Warwick. 2003. Recovery of soft sediment communities and habitats following physical disturbance. Journal of experimental Marine Biology and Ecology 285-286: 415-434.

Dethier, M.N., W.W. Raymond, A.N. McBride, J.D. Toft, J.R. Cordell, A.S. Ogston, S.M. Heerhartz, and H.D. Berry. 2016. Multiscale impacts of armoring on Salish Sea shorelines: Evidence for cumulative and threshold effects. Estuarine, Coastal and Shelf Science. 175:106-117.

Drake, J. S., E. A. Berntson, J. M. Cope, R. G. Gustafson, E. E. Holmes, P. S. Levin, N. Tolimieri, R. S. Waples, S. M. Sogard, and G. D. Williams. 2010. Status Review of Five Rockfish Species in Puget Sound, Washington Bocaccio (Sebastes paucispinis), Canary Rockfish (S. pinniger), Yelloweye Rockfish (S. ruberrimus), Greenstriped Rockfish (S. elongatus), and Redstripe Rockfish (S. proriger). December 2010. NOAA Technical Memorandum NMFS-NWFSC-108. 247p.

Driscoll, E. D., P.E. Shelly, and E.W. Strecker. 1990. Pollutant loadings and impacts from highway stormwater runoff, volume III—Analytical investigation and research report: U.S. Federal Highway Administration Final Report FHWA-RD-88-008, 160 p

Erbe, C. and C. McPherson. 2017. Radiated noise levels

Eriksson, B. K., et al. (2004). Effects of boating activities on aquatic vegetation in the Stockholm archipelago, Baltic Sea. Estuarine, Coastal and Shelf Science 61(2): 339-349.

Feist, B. E., E. R. Buhle, P. Arnold, J. W. Davis, N. L. Scholz. 2011 Landscape Ecotoxicology of Coho Salmon Spawner Mortality in Urban Streams. PLoS ONE 6(8): e23424. https://doi.org/10.1371/journal.pone.0023424

French, B.F., Baldwin, D.H., Cameron, J., Prat, J., King, K., Davis, J.W., McIntyre, J.K. and Scholz, N.L., 2022. Urban Roadway Runoff Is Lethal to Juvenile Coho, Steelhead, and Chinook Salmonids, But Not Congeneric Sockeye. Environmental Science & Technology Letters, 9(9), pp.733-738.

Fresh K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

Ford, J. K. B., G. M. Ellis, P. F. Olesiuk, and K. C. Balcomb. 2010. Linking killer whale survival and prey abundance: food limitation in the oceans' apex predator? Biology Letters 6:139-142.

Ford, M. J., (ed.). 2022. Biological Viability Assessment Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Pacific Northwest. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-171. https://doi.org/10.25923/kq2n-ke70

Good, T.P., June, J.A., Etnier, M.A. and Broadhurst, G. 2010. Derelict fishing nets in Puget Sound and the Northwest Straits: patterns and threats to marine fauna. Marine Pollution Bulletin, 60(1), pp.39-50.

Haas, M.E., Simenstad, C.A., Cordell, J.R., Beauchamp, D.A., Miller, B.S. and Stotz, T. 2002. Effects of large overwater structures on epibenthic juvenile salmon prey assemblages in Puget Sound, Washington (No. WA-RD 550.1,). Washington State Department of Transportation.

Hamel, N., J. Joyce, M. Fohn, A. James, J. Toft, A. Lawver, S. Redman and M. Naughton (Eds). 2015. 2015 State of the Sound: Report on the Puget Sound Vital Signs. November 2015. 86 pp. www.psp.wa.gov/sos.

Hanson MB, Emmons CK, Ford MJ, Everett M, Parsons K, et al. (2021) Endangered predators and endangered prey: Seasonal diet of Southern Resident killer whales. PLOS ONE 16(3): e0247031. Accessed via https://doi.org/10.1371/journal.pone.0247031

Harris, K. A., M. B Yunker, N. Dangerfield, P. S. Ross. 2011. Sediment-associated aliphatic and aromatic hydrocarbons in coastal British Columbia, Canada: Concentrations, composition, and associated risks to protected sea otters. Environmental Pollution. V159, I10. Oct 2011. Accessed via https://www.sciencedirect.com/science/article/pii/S0269749111003204

Heiser, D.W., and E.L. Finn 1970. Observations of Juvenile Chum and Pink Salmon in Marina and Bulkheaded Areas. State of Washington Department of Fisheries.

Joint Base Lewis McCord (JBLM). 2019. Environmental Assessment Integrated Natural Resources Management Plan. Prepared by Joint Base Lewis-McChord Public Works Environmental Division. January 2019.

Johnson, L. L., G.M. Ylitalo, M.R. Arkoosh, A.N. Kagley, C.L. Stafford, J.L. Bolton, J. Buzitis, B.F. Anulacion, and T.K. Collier. 2007. Contaminant exposure in outmigrant juvenile salmon from Pacific Northwest estuaries. Environmental Monitoring and Assessment 124:167-194.

JBLM. 2013a. Endangered Species Management Plan for the Threatened Species Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha*), Puget Sound Steelhead (*Oncorhynchus mykiss*), and Bull Trout – Coastal/Puget Sound (*Salvelinus confluentus*). Prepared by Joint Base Lewis-McChord Public Works Environmental Division. April 2013 – March 2018.

JBLM. 2013b. Endangered Species Management Plan for the Threatened Species Puget Sound/Georgia Basin Distinct Population Segment of Canary rockfish (*Sebastes pinniger*), and Yelloweye rockfish (*Sebastes ruberrimus*) and the Endangered Species Bocaccio (*Sebastes paucispinis*), Prepared by Joint Base Lewis-McChord Public Works Environmental Division. April 2013 – March 2018.

Kagawa, J. 2002. Health effects of diesel exhaust emissions – a mixture of air pollutants of worldwide concern. Toxicology, pp. 349-353

Kayhanian, M., A. Singh, C. Suverkropp, and S. Borroum. 2003. Impact of annual average daily traffic on highway runoff pollutant concentrations. J. Environ. Eng., 129 (2003), pp. 975- 990

Kagley, A., J.M. Smith, M.C. Arostegui, J.W. Chamberlin, D. Spilsbury-Pucci, K. L. Fresh, K.E. Frick, and T.P. Quinn. 2016. Movements of sub-adult Chinook salmon (Oncorhynchus tshawytscha) in Puget Sound, Washington, as indicated by hydroacoustic tracking. Presented at Salish Sea Ecosystem Conference, Vancouver, BC, Canada.

Kelty, R., and S. Bliven. 2003. Environmental and aesthetic impacts of small docks and piers workshop report: Developing a science-based decision support tool for small dock management, phase 1: Status of the science. In Decision Analysis Series No. 22. N.C.O. Program, editor.

LaSalle, M.W, J Nestler, A. C Miller. 1988. Seasonal Regulation of Repair Evaluation, Maintenance, and Rehabilitation (REMR) Activities. Repair, Evaluation, Maintenance, and Rehabilitation Research Program. Accessed via https://apps.dtic.mil/sti/pdfs/ADA198016.pdf

Law, R.J., V.J. Dawes, R.J. Woodhead and P. Matthiessen. 1997. Polycyclic Aromatic Hydrocarbons (PAH) in Seawater around England and Wales. Ministry of Agriculture, Fisheries and Food, Fisheries Laboratory, Remembrance Avenue, Burnham-on-Crouch, Essex CMO 8HA, UK

Loge, F., M.R. Arkoosh, T.R. Ginn, L.L. Johnson, and T.K. Collier. 2006. Impact of environmental stressors on the dynamics of disease transmission. Environmental Science & Technology 39(18):7329-7336.

Masters, Darin. Personal Communication. 2022. Solo Point applicability of Washington laws, WDFW roll at JBLM, site specific knowledge, perennial stream and fish passage, appropriate riparian plantings. January 6, 2022.

Morley, S.A., J.D. Toft, and K.M. Hanson. 2012. Ecological Effects of Shoreline Armoring on Intertidal Habitats of a Puget Sound Urban Estuary. Estuaries and Coasts. 35:774-784.

Mumford, T.F. 2007. Kelp and Eelgrass in Puget Sound in Valued Ecosystem Component Reports Series. Washington Department of Natural Resources, Olympia, WA.

Munsch, S.H., J.R. Cordell, J.D. Toft, and E.E. Morgan. 2014. Effects of Seawalls and Piers on Fish Assemblages and Juvenile Salmon Feeding Behavior. North American Journal of Fisheries Management. 34:814-827.

National Marine Fisheries Service (NMFS). 2023. ESA Section 7 Consultation Tools for Marine Mammals on the West Coast. Webpage. Accessed via https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/esa-section-7-consultation-tools-marine-mammals-west#evaluating-potential-occurrence-of-sound

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. 16:34.

NRC (National Research Council). 2014. Estimates of remaining derelict fishing gear in the Puget Sound. Electronic communication between Kyle Antonelis (NRC) and Dan Tonnes (NOAA) April 4, 2014.

Nightingale, B. and C. Simenstad. 2001b. Overwater structures: Marine issues. Prepared for Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. University of Washington. Seattle, WA.

Nightingale, B, and C.A. Simenstad. 2001a. White paper: Dredging Activities: Marine Issues. Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation, Olympia, WA. 184pp.

PFMC(Pacific Fishery Management Council). 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon.

PFMC. 2008. Management of krill as an essential component of the California Current ecosystem. Amendment 12 to the Coastal Pelagic Species Fishery Management Plan. Environmental assessment, regulatory impact review & regulatory flexibility analysis. Pacific Fishery Management Council, Portland, Oregon. February.]

PFMC. 1998. Description and identification of essential fish habitat for the Coastal Pelagic Species Fishery Management Plan. Appendix D to Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon. December.

Parks, D., A. Shaffer, and D. Barry. 2013. Nearshore drift-cell sediment processes and ecological function for forage fish: implications for ecological restoration of impaired Pacific Northwest marine ecosystems. J. Coast. Res. 29:984–997.

Patrick, C. J., D.E. Weller, X. Li. and M. Ryder. 2014. Effects of shoreline alteration and other stressors on submerged aquatic vegetation in subestuaries of Chesapeake Bay and the mid-Atlantic coastal bays. Estuaries and coasts, 37(6), 1516-1531.

Penttila, D., 2007. Marine forage fishes in Puget Sound: Seattle, Wash. Washing Department of Fish and Wildlife. Puget Sound Nearshore Partnership Report 2007-03. Accessed via https://wdfw.wa.gov/sites/default/files/publications/02193/wdfw02193.pdf

Puget Sound Partnership (PSP). 2019. State of the Sound Report. Olympia, Washington. November 2019. 79 pp. www.stateofthesound.wa.gov

REEF. 2023. Reef Environmental Education Foundation Volunteer Fish Survey Project Database. Geographic Zone Reporst for Solo Point (1 survey), Saltar's Point (8 surveys), and Sunnyside Beach (266 surveys). SCUBA surveys conducted from Jan 1, 1993 through June 2023 Accessed via https://www.reef.org/db/reports/

Rice, C. A., C. M. Greene, P. Moran, D. J. Teel, D. R. Kuligowski, R. R. Reisenbichler, E. M. Beamer, J. R. Karr, K. L. Fresh. 2011. Abundance, Stock Origin, and Length of Marked and Unmarked Juvenile Chinook Salmon in the Surface Waters of Greater Puget Sound. Transactions of the American Fisheries Society. V 140 I1. Pp 170-189. Accessed via https://afspubs.onlinelibrary.wiley.com/doi/10.1080/00028487.2010.550253

Rice, C. A. 2006. Effects of shoreline modification on a northern Puget Sound beach: microclimate and embryo mortality in surf smelt (Hypomesus pretiosus). Estuaries and Coasts. 29(1): 63-71.

Sandahl, J.F., D.H. Baldwin, J.J. Jenkins, and N.L. Scholz. 2007. A sensory system at the interface between urban stormwater runoff and salmon survival. Environmental Science & Technology 41(8):2998-3004

Schlacher. T. & L. M. C. Thompson. 2007. Exposure of Fauna to Off-Road Vehicle (ORV) Traffic on Sandy Beaches. Coastal Management. V35 I5. Accessed via https://www.tandfonline.com/doi/full/10.1080/08920750701593402

Schlenger, P., A. MacLennan, E. Iverson, K. Fresh, C. Tanner, B. Lyons, S. Todd, R. Carman, D. Myers, S. Campbell, and A. Wick. 2011. Strategic Needs Assessment: Analysis of Nearshore Ecosystem Process Degradation in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project.

Scholz, N.L., M.S. Myers, S.G. McCarthy, J.S. Labenia, J.K. McIntyre, G.M. Ylitalo, L.D. Rhodes, C.A. Laetz, C.M. Stehr, B.L. French, B. McMillan, D. Wilson, L. Reed, K.D. Lynch, S. Damm, J.W. Davis, and T.K. Collier. 2011. Recurrent die-offs of adult coho salmon returning to spawn in Puget Sound lowland urbans streams. PLoS ONE 6: e28013. doi.10.1371/journal.pone.0028013.

Servizi, J.A. and D.W. Martens. 1992. Sublethal responses of coho salmon (Oncorhynchus kisutch) to suspended sediments. Canadian Journal of Fisheries and Aquatic Sciences 49: 1389-1395.

Shafer, D.J. 1999. The effects of dock shading on the seagrass Halodule wrightii in Perdido Bay, Alabama. Estuaries. 22:936-943.

Shafer, D.J. 2002. Recommendations to minimize potential impacts to seagrasses from single family residential dock structures in the PNW. S.D. Prepared for the U.S. Army Corps of Engineers, editor.

Shipman, H., Dethier, M. N., Gelfenbaum, G., Fresh, K. L. and Dinicola, R. S. (Eds.). 2010. Puget Sound Shorelines and the Impacts of Armoring-- Proceedings of a State of the Science Workshop, May 2009. U.S. Geological Survey, Scientific Investigations Report 2010-5254.

Simenstad, C.A., M. Ramirez, B.J. Burke, M. Logsdon, H. Shipman, C. Tanner, Toft J., B. Craig, C. Davis, J. Fung, P. Bloch, K.L. Fresh, S. Campbell, D. Myers, E. Iverson, A. Bailey, P. Schlenger, C. Kiblinger, P. Myre, W.I. Gertsel, and A. MacLennan. 2011. Historical Changes and Impairment of Puget Sound Shorelines. In Puget Sound Nearshore Ecosystem Restoration Project.

Simenstad, C.A., Thom, R.M., Kuzis, K.A., Cordell, J.R. and Shreffler, D.K. 1988. Nearshore community studies of Neah Bay, Washington. Washington University Seattle Fisheries Research Institute.

Sobocinski, K.L., J.R. Cordell and C.A. Simenstad. 2010. Effects of Shoreline Modifications on Supratidal Macroinvertebrate Fauna on Puget Sound, Washington Beaches. Estuaries and Coasts. 33:699-711.

Spromberg, J. A., and J.P. Meador. 2006. Relating chronic toxicity responses to population-level effects: A comparison of population-level parameters for three salmon species as a function of low-level toxicity. Ecological Modeling 199:240-252

Strelkov, A. K. S.V. Stephanov. S Y Teplykh, A.M. Sargsyan. 2016. Monitoring pollution level in railroad right-of-way. International Conference – Environment at a Crossroads: SMART approaches for a sustainable future. Procedia Environmental Sciences 32 (2016) 147 – 154. Accessed via https://pdf.sciencedirectassets.com/

Sutton, M. V., 2019. Quinone methides: multifunctional tools for chemical biology and material science (Doctoral dissertation, University of Georgia).

Toft, J.D., J.R. Cordell, C.A. Simenstad, and L.A. Stamatiou. 2007. Fish distribution, abundance, and behavior along city shoreline types in Puget Sound. North American Journal of Fisheries Management. 27, 465-480.

Toft, J.D., Ogston, A.S., Heerhartz, S.M., Cordell, J.R. and Flemer, E.E. 2013. Ecological response and physical stability of habitat enhancements along an urban armored shoreline. Ecological Engineering, 57, pp.97-108.

Tonnes. D., M. Bhuthimethee, J. Sawchuck, N. Tolimieri, K. Andrews, K. Nichols. 2016. 5-Year Review: Yelloweye Rockfish, Canary Rockfish, and Bocaccio of the Puget Sound/Georgia Basin. NOAA Fisheries West Coast Region. Accessed on Feb 7, 2023 via https://repository.library.noaa.gov/view/noaa/17805

United States Geological Survey. 2023. The National Map - Elevation Tool "Profile Tool". Accessed via https://apps.nationalmap.gov/elevation/

WDFW. 2009a. The Biology and Assessment of Rockfishes in Puget Sound. Sept 2009. Palsson, Tsou, Bargmann, Buckley, West, Mills, Cheng, and Pacunski. FPT 09-04. Accessed via. https://www.researchgate.net/profile/WaynePalsson/publication/324833293_The_Biology_and_Assessment_of_Rockfishes_in_Puget_Sound/links/604a98b4299bf1f5d840d93b/The-Biology-and-Assessment-of-Rockfishesin-Puget-Sound.pdf

WDFW. 2009b. Protection of Marine Riparian Functions in Puget Sound, Washington. Prepared for WDFW by Washington Sea Grant. Accessed via https://wdfw.wa.gov/sites/default/files/publications/00693/wdfw00693.pdf

Washington Department of Natural Resources (WADNR). 2023. Aquatic Resources Interactive Map – Aquatic Reserves. Accessed via https://aquarim.dnr.wa.gov/default.aspx

Washington Department of Ecology (Ecology). 2023 Water Quality Atlas. Accessed via https://apps.ecology.wa.gov/waterqualityatlas/

Ecology. 2019. Stormwater Management Manual for Western Washington. July 219. Prepared by Washington State Department of Ecology Water Quality Program. Publication number 19-10-022. Accessed via https://fortress.wa.gov/ecy/ezshare/wq/Permits/Flare/2019SWMMWW/Content/Resources/DocsForDownload/2019SWMMWW.pdf

Washington Department of Fish and Wildlife (WDFW). 2023. Salmonscape. Online application. Accessed via https://apps.wdfw.wa.gov/salmonscape/map.html

WDFW 2014. Marine Shoreline Design Guidelines. Prepared for the Aquatic Habitat Guidelines Program. Authors J Johannessen, A. MacLennan , A. Blue , J. Waggoner , S. Williams, W. Gerstel, R. Barnard, R. Carman , and H. Shipman. Chapter 7 Technicque 1 Beach Nourishment. Accessed via https://wdfw.wa.gov/sites/default/files/publications/01583/wdfw01583.pdf#page=123&zoom=100,68,96

Willette, T.M. 2001. Foraging behaviour of juvenile pink salmon *(Oncorhynchus gorbuscha*) and size-dependent predation risk. Fisheries Oceanography. https://onlinelibrary.wiley.com/doi/full/10.1046/j.1054-6006.2001.00042.x

Zhang, A., Zhao, S., Wang, L., Yang, X., Zhao, Q., Fan, J. and Yuan, X., 2016. Polycyclic aromatic hydrocarbons (PAHs) in seawater and sediments from the northern Liaodong Bay, China. Marine Pollution Bulletin, 113(1-2), pp.592-599.

INCLUDE NMFS STEElHEAD RECOVERY PLAN – need date in baseline section.

Climate Literature

Agne, M.C., P.A. Beedlow, D.C. Shaw, D.R. Woodruff, E.H. Lee, S.P. Cline, and R.L. Comeleo. 2018. Interactions of predominant insects and diseases with climate change in Douglas-fir forests of western Oregon and Washington, U.S.A. Forest Ecology and Management 409(1). https://doi.org/10.1016/j.foreco.2017.11.004

Alizedeh, M.R., J.T. Abatzoglou, C.H. Luce, J.F. Adamowski, A. Farid, and M. Sadegh. 2021. Warming enabled upslope advance in western US forest fires. PNAS 118(22) e2009717118. https://doi.org/10.1073/pnas.2009717118

Anderson, S. C., J. W. Moore, M. M. McClure, N. K. Dulvy, and A. B. Cooper. 2015. Portfolio conservation of metapopulations under climate change. Ecological Applications 25:559-572.

Barnett, H.K., T.P. Quinn, M. Bhuthimethee, and J.R. Winton. 2020. Increased prespawning mortality threatens an integrated natural- and hatchery-origin sockeye salmon population in the Lake Washington Basin. Fisheries Research 227. https://doi.org/10.1016/j.fishres.2020.105527

Beechie, T., E. Buhle, M. Ruckelshaus, A. Fullerton, and L. Holsinger. 2006. Hydrologic regime and the conservation of salmon life history diversity. Biological Conservation, 130(4), pp.560-572.

Black, B.A., P. van der Sleen, E. Di Lorenzo, D. Griffin, W.J. Sydeman, J.B. Dunham, R.R. Rykaczewski, M. García-Reyes, M. Safeeq, I. Arismendi, and S.J. Bograd. 2018. Rising synchrony controls western North American ecosystems. Global change biology, 24(6), pp. 2305-2314.

Braun, D.C., J.W. Moore, J. Candy, and R.E. Bailey. 2016. Population diversity in salmon: linkages among response, genetic and life history diversity. Ecography, 39(3), pp.317-328.

Burke, B.J., W.T. Peterson, B.R. Beckman, C. Morgan, E.A. Daly, M. Litz. 2013. Multivariate Models of Adult Pacific Salmon Returns. PLoS ONE 8(1): e54134. https://doi.org/10.1371/journal.pone.0054134

Busby, P.J., T.C. Wainwright, G.J. Bryant, L.J. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino. 1996. Status review of west coast steelhead from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-27, 131 p.

Carr-Harris, C.N., J.W. Moore, A.S. Gottesfeld, J.A. Gordon, W.M. Shepert, J.D. Henry Jr, H.J. Russell, W.N. Helin, D.J. Doolan, and T.D. Beacham. 2018. Phenological diversity of salmon smolt migration timing within a large watershed. Transactions of the American Fisheries Society, 147(5), pp.775-790.

Chasco, B. E., B. J. Burke, L. G. Crozier, and R. W. Zabel. 2021. Differential impacts of freshwater and marine covariates on wild and hatchery Chinook salmon marine survival. PLoS ONE 16:e0246659. https://doi.org/0246610.0241371/journal.pone.0246659.

Cooper, M.G., J. R. Schaperow, S. W. Cooley,S. Alam,L. C. Smith, D. P. Lettenmaier. 2018. Climate Elasticity of Low Flows in the Maritime Western U.S. Mountains. Water Resources Research. https://doi.org/10.1029/2018WR022816

Crozier, L. 2015. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2014. Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region.

Crozier, L. 2016. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2015. Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region.

Crozier, L. 2017. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2016. Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region.

Crozier, L. G., and J. Siegel. 2018. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2017. Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region.

Crozier, L.G. and R.W. Zabel. 2006. Climate impacts at multiple scales: evidence for differential population responses in juvenile Chinook salmon. Journal of Animal Ecology. 75:1100-1109.

Crozier, L., R.W. Zabel, S. Achord, and E.E. Hockersmith. 2010. Interacting effects of density and temperature on body size in multiple populations of Chinook salmon. Journal of Animal Ecology. 79:342-349.

Crozier L.G., M.M. McClure, T. Beechie, S.J. Bograd, D.A. Boughton, M. Carr, T. D. Cooney, J.B. Dunham, C.M. Greene, M.A. Haltuch, E.L. Hazen, D.M. Holzer, D.D. Huff, R.C. Johnson, C.E. Jordan, I.C. Kaplan, S.T. Lindley, N.Z. Mantua, P.B. Moyle, J.M. Myers, M.W. Nelson, B.C. Spence, L.A. Weitkamp, T.H. Williams, and E. Willis-Norton. 2019. Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. PLoS ONE 14(7): e0217711. https://doi.org/10.1371/journal.pone.0217711

Crozier, L.G., B.J. Burke, B.E. Chasco, D.L. Widener, and R.W. Zabel. 2021. Climate change threatens Chinook salmon throughout their life cycle. Communications biology, 4(1), pp.1-14.

Dorner, B., M.J. Catalano, and R.M. Peterman. 2018. Spatial and temporal patterns of covariation in productivity of Chinook salmon populations of the northeastern Pacific Ocean. Canadian Journal of Fisheries and Aquatic Sciences, 75(7), pp.1082-1095.

Federal Register. 70 FR 52629. 2006. 12 Evolutionarily Significant Units of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho.

Federal Register. 79 FR 68041. 2014. Designation of Critical Habitat for the Puget Sound/Georgia Basin Distinct Population Segments of Yelloweye Rockfish, Canary Rockfish and Bocaccio.

Federal Register. 86 FR 41668. 2014. Revision of Critical Habitat for the Southern Resident Killer Whale Distinct Population Segment.

Ford, M. J. (editor). 2022. Biological Viability Assessment Update for Pacific Salmon and Steelhead Listed Under the Endangered Species Act: Pacific Northwest. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-171.

FitzGerald, A.M., S.N. John, T.M. Apgar, N.J. Mantua, and B.T. Martin. 2020. Quantifying thermal exposure for migratory riverine species: Phenology of Chinook salmon populations predicts thermal stress. Global Change Biology 27(3).

Freshwater, C., S. C. Anderson, K. R. Holt, A. M. Huang, and C. A. Holt. 2019. Weakened portfolio effects constrain management effectiveness for population aggregates. Ecological Applications 29:14.

Gliwicz, Z.M., E. Babkiewicz, R. Kumar, S. Kunjiappan, and K. Leniowski, 2018. Warming increases the number of apparent prey in reaction field volume of zooplanktivorous fish. Limnology and Oceanography, 63(S1), pp.S30-S43.

Gosselin, J. L., Buhle, E. R., Van Holmes, C., Beer, W. N., Iltis, S., & Anderson, J. J. 2021. Role of carryover effects in conservation of wild Pacific salmon migrating regulated rivers. Ecosphere, 12(7), e03618.

Gourtay, C., D. Chabot, C. Audet, H. Le Delliou, P. Quazuguel, G. Claireaux, and J.L. Zambonino-Infante. 2018. Will global warming affect the functional need for essential fatty acids in juvenile sea bass (Dicentrarchus labrax)? A first overview of the consequences of lower availability of nutritional fatty acids on growth performance. Marine Biology, 165(9), pp.1-15.

Gustafson, R.G., T.C. Wainwright, G.A. Winans, F.W. Waknitz, L.T. Parker, and R.S. Waples. 1997. Status review of sockeye salmon from Washington and Oregon. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-33, 282 p.

Hard, J.J., R.G. Kope, W.S. Grant, F.W. Waknitz, L.T. Parker, and R.S. Waples. 1996. Status review of pink salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-25, 131 p.

Halofsky, J.S., D.R. Conklin, D.C. Donato, J.E. Halofsky, and J.B. Kim. 2018. Climate change, wildfire, and vegetation shifts in a high-inertia forest landscape: Western Washington, U.S.A. PLoS ONE 13(12): e0209490. https://doi.org/10.1371/journal.pone.0209490

Halofsky, J.E., Peterson, D.L. and B. J. Harvey. 2020. Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. Fire Ecology 16(4). https://doi.org/10.1186/s42408-019-0062-8

Healey, M., 2011. The cumulative impacts of climate change on Fraser River sockeye salmon (Oncorhynchus nerka) and implications for management. Canadian Journal of Fisheries and Aquatic Sciences, 68(4), pp.718-737.

Herring, S. C., N. Christidis, A. Hoell, J. P. Kossin, C. J. Schreck III, and P. A. Stott, Eds., 2018: Explaining Extreme Events of 2016 from a Climate Perspective. Bull. Amer. Meteor. Soc., 99 (1), S1–S157.

Holden, Z.A., A. Swanson, C.H. Luce, W.M. Jolly, M. Maneta, J.W. Oyler, D.A. Warren, R. Parsons and D. Affleck. 2018. Decreasing fire season precipitation increased recent western US forest wildfire activity. PNAS 115(36). https://doi.org/10.1073/pnas.1802316115

Holsman, K.K., M.D. Scheuerell, E. Buhle, and R. Emmett. 2012. Interacting effects of translocation, artificial propagation, and environmental conditions on the marine survival of Chinook Salmon from the Columbia River, Washington, USA. Conservation Biology, 26(5), pp.912-922.

Intergovernmental Panel on Climate Change (IPCC) Working Group I (WGI). 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou editor. Cambridge University Press (https://www.ipcc.ch/report/ar6/wg1/#FullReport).

IPCC Working Group II (WGII). 2022. Climate Change 2022: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. H.O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, and B. Rama (eds.) Cambridge University Press (https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_FinalDraft_FullReport.pdf)

Isaak, D.J., C.H. Luce, D.L. Horan, G. Chandler, S. Wollrab, and D.E. Nagel. 2018. Global warming of salmon and trout rivers in the northwestern U.S.: Road to ruin or path through purgatory? Transactions of the American Fisheries Society. 147: 566-587. https://doi.org/10.1002/tafs.10059

Jacox, M. G., Alexander, M. A., Mantua, N. J., Scott, J. D., Hervieux, G., Webb, R. S., & Werner, F. E. 2018. Forcing of multi-year extreme ocean temperatures that impacted California Current living marine resources in 2016. Bull. Amer. Meteor. Soc, 99(1).

Johnson, B.M., G.M. Kemp, and G.H. Thorgaard. 2018. Increased mitochondrial DNA diversity in ancient Columbia River basin Chinook salmon Oncorhynchus tshawytscha. PLoS One, 13(1), p.e0190059.

Johnson, O.W., W.S. Grant, R.G. Kope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-32, 280 p.

Keefer M.L., T.S. Clabough, M.A. Jepson, E.L. Johnson, C.A. Peery, C.C. Caudill. 2018. Thermal exposure of adult Chinook salmon and steelhead: Diverse behavioral strategies in a large and warming river system. PLoS ONE 13(9): e0204274. https://doi.org/10.1371/journal.pone.0204274

Kilduff, D. P., L.W. Botsford, and S.L. Teo. 2014. Spatial and temporal covariability in early ocean survival of Chinook salmon (Oncorhynchus tshawytscha) along the west coast of North America. ICES Journal of Marine Science, 71(7), pp.1671-1682.

Koontz, E.D., E.A. Steel, and J.D. Olden. 2018. Stream thermal responses to wildfire in the Pacific Northwest. Freshwater Science, 37, 731 - 746.

Krosby, M. D.M. Theobald, R. Norheim, and B.H. McRae. 2018. Identifying riparian climate corridors to inform climate adaptation planning. PLoS ONE 13(11): e0205156. https://doi.org/10.1371/journal.pone.0205156

Lambert, M. B. and J. Chamberlain. 2023. Beach nourishment in Puget Sound: status, use, and habitat impacts. Science Synthesis white paper. NMFS Science Sprint. https://salishsearestoration.org/w/images/5/5e/Lambert_%26_Chamberlin_2023_beach_nourishment_science_synthesis.pdf

Lindley S.T., C.B. Grimes, M.S. Mohr, W. Peterson, J. Stein, J.T. Anderson, et al. 2009. What caused the Sacramento River fall Chinook stock collapse? NOAA Fisheries West Coast Region, Santa Cruz, CA. U.S. Department of Commerce NOAA-TM-NMFS-SWFSC-447.

Malek, K., J.C. Adam, C.O. Stockle, and R.T. Peters. 2018. Climate change reduces water availability for agriculture by decreasing non-evaporative irrigation losses. Journal of Hydrology 561:444-460.

Munsch, S. H., C. M. Greene, N. J. Mantua, and W. H. Satterthwaite. 2022. One hundred-seventy years of stressors erode salmon fishery climate resilience in California's warming landscape. Global Change Biology.

Myers, J.M., J. Jorgensen, M. Sorel, M. Bond, T. Nodine, and R. Zabel. 2018. Upper Willamette River Life Cycle Modeling and the Potential Effects of Climate Change. Draft Report to the U.S. Army Corps of Engineers. Northwest Fisheries Science Center. 1 September 2018.

Myers, J.M., R.G. Kope, G.J. Bryant, D. Teel, L.J. Lierheimer, T.C. Wainwright, W.S. Grant, F.W. Waknitz, K. Neely, S.T. Lindley, and R.S. Waples. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-35, 443 p.

NOAA National Centers for Environmental Information (NCEI), State of the Climate: Global Climate Report for Annual 2021, published online January 2022, retrieved on February 28, 2022 from https://www.ncdc.noaa.gov/sotc/global/202113.

NMFS. 2016c. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation and Fish and Wildlife Coordination Act Recommendations for Regional General Permit 6 (RGP-6): Structures in Inland Marine Waters of Washington State Puget Sound. WCR-2016-4361. September13, 2016.

NMFS. 2020a. Endangered Species Act (ESA) Section 7(a)(2) Jeopardy Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Response for the Issuance of Permits for 39 Projects under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for Actions related to Structures in the Nearshore Environment of Puget Sound. November 9, 2020. NMFS Consultation Number: WCRO-2020-01361. 329p.

NMFS. 2022. 2021 Southern Resident Killer Whales (Orcinus orca) 5-Year Review: Summary and Evaluation January 04, 2022

Ohlberger, J., E.J. Ward, D.E. Schindler, and B. Lewis. 2018. Demographic changes in Chinook salmon across the Northeast Pacific Ocean. Fish and Fisheries, 19(3), pp.533-546.

Olmos M., M.R. Payne, M. Nevoux, E. Prévost, G. Chaput, H. Du Pontavice, J. Guitton, T. Sheehan, K. Mills, and E. Rivot. 2020. Spatial synchrony in the response of a long range migratory species (Salmo salar) to climate change in the North Atlantic Ocean. Glob Chang Biol. 26(3):1319-1337. doi: 10.1111/gcb.14913. Epub 2020 Jan 12. PMID: 31701595.

Ono, K. 2010. Assessing and Mitigating Dock Shading Impacts on the Behavior of Juvenile Pacific Salmon (Oncorhynchus spp.): can artificial light mitigate the effects? In School of Aquatic and Fishery Sciences. Vol. Master of Science. University of Washington.

Ou, M., T. J. Hamilton, J. Eom, E. M. Lyall, J. Gallup, A. Jiang, J. Lee, D. A. Close, S. S. Yun, and C. J. Brauner. 2015. Responses of pink salmon to CO2-induced aquatic acidification. Nature Climate Change 5:950-955. Palsson, W.A., Tsou, T.S., Bargmann, G.G., Buckley, R.M., West, J.E., Mills, M.L., Cheng,

Palsson, Y.W. and Pacunski, R.E. 2009. The biology and assessment of rockfishes in Puget Sound. Washington Department of Fish and Wildlife, Fish Management Division, Olympia, Washington, USA.

Schindler, D. E., J. B. Armstrong, and T. E. Reed. 2015. The portfolio concept in ecology and evolution. Frontiers in Ecology and the Environment 13:257-263.

Siegel, J., and L. Crozier. 2019. Impacts of Climate Change on Salmon of the Pacific Northwest. A review of the scientific literature published in 2018. Fish Ecology Division, NWFSC. December 2019.

Siegel, J., and L. Crozier. 2020. Impacts of Climate Change on Salmon of the Pacific Northwest: A review of the scientific literature published in 2019. National Marine Fisheries Service, Northwest Fisheries Science Center, Fish Ecology Division. https://doi.org/10.25923/jke5-c307

Southard, S.L., R.M. Thom, G.D. Williams, T.J. D., C.W. May, G.A. McMichael, J.A. Vucelick, J.T. Newell, and J.A. Southard. 2006. Impacts of Ferry Terminals on Juvenile Salmon Movement along Puget Sound Shorelines. Battelle Memorial Institute, Pacific Northwest Division.

Sridhar, V., M.M. Billah, J.W. Hildreth. 2018. Coupled Surface and Groundwater Hydrological Modeling in a Changing Climate. Groundwater Vol. 56, Issue 4. https://doi.org/10.1111/gwat.12610

Stachura, M.M., N.J. Mantua, and M.D. Scheuerell. 2014. Oceanographic influences on patterns in North Pacific salmon abundance. Canadian Journal of Fisheries and Aquatic Sciences, 71(2), pp.226-235.

Sturrock, A.M., S.M. Carlson, J.D. Wikert, T. Heyne, S. Nusslé, J.E. Merz, H.J. Sturrock and R.C. Johnson. 2020. Unnatural selection of salmon life histories in a modified riverscape. Global Change Biology, 26(3), pp.1235-1247.

Toft, J.D., J.R. Cordell, C.A. Simenstad, and L.A. Stamatiou. 2007. Fish distribution, abundance, and behavior along city shoreline types in Puget Sound. North American Journal of Fisheries Management. 27, 465-480.

Toft, J.D., Ogston, A.S., Heerhartz, S.M., Cordell, J.R. and Flemer, E.E. 2013. Ecological response and physical stability of habitat enhancements along an urban armored shoreline. Ecological Engineering, 57, pp.97-108.

Thorne, K., G. MacDonald, G. Guntenspergen, R. Ambrose, K. Buffington, B. Dugger, C. Freeman, C. Janousek, L. Brown, J. Rosencranz, J. Holmquist, J. Smol, K. Hargan, and J. Takekawa. 2018. U.S. Pacific coastal wetland resilience and vulnerability to sea-level rise. Science Advances 4(2). DOI: 10.1126/sciadv.aao3270

Veilleux, H.D., Donelson, J.M. and Munday, P.L., 2018. Reproductive gene expression in a coral reef fish exposed to increasing temperature across generations. Conservation physiology, 6(1), p.cox077.

Wainwright, T.C. and L.A. Weitkamp. 2013. Effects of climate change on Oregon Coast coho salmon: habitat and life-cycle interactions. Northwest Science, 87(3), pp.219-242.

Ward, E.J., J.H. Anderson, T.J. Beechie, G.R. Pess, M.J. Ford. 2015. Increasing hydrologic variability threatens depleted anadromous fish populations. Glob Chang Biol. 21(7):2500–9. Epub 2015/02/04. pmid:25644185.

Washington Department of Natural Resources (WADNR). 2011. Nisqually Reach Aquatic Reserve Management Plan. September 2011. Aquatic Resources Division. Accessed via https://www.dnr.wa.gov/publications/aqr_resv_nr_mgmtplan_2011.pdf

Weitkamp, L.A., T.C. Wainwright, G.J. Bryant, G.B. Milner, D.J. Teel, R.G. Kope, and R.S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-24, 258 p.

Williams, T.H., B.C. Spence, D.A. Boughton, R.C. Johnson, L.G. Crozier, N.J. Mantua, M.R. O'Farrell, and S.T. Lindley. 2016. Viability assessment for Pacific salmon and steelhead listed under the Endangered Species Act: Southwest. NOAA Fisheries Southwest Fisheries Science Center, Santa Cruz, CA: U.S. Dep Commerce NOAA Tech Memo NMFS SWFSC 564.

Williams, C. R., A. H. Dittman, P. McElhany, D. S. Busch, M. T. Maher, T. K. Bammler, J. W. MacDonald, and E. P. Gallagher. 2019. Elevated CO2 impairs olfactory-mediated neural and behavioral responses and gene expression in ocean-phase coho salmon (Oncorhynchus kisutch). 25:963-977.

Yan, H., N. Sun, A. Fullerton, and M. Baerwalde. 2021. Greater vulnerability of snowmelt-fed river thermal regimes to a warming climate. Environmental Research Letters 16(5). https://doi.org/10.1088/1748-9326/abf393