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

Refer to NMFS No.:
WCRO-2019-00727

September 28, 2020

Michelle Walker
Corps of Engineers, Seattle District
Regulatory Branch CENWS-OD-RG
P.O. Box 3755
Seattle, Washington 98124-3755

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Tacoma Jefferson-Hood Street stormwater outfall, Pierce County, Washington, COE Number: NWS-2017-595, HUC: 171100120400 – Foss Waterway.

Dear Ms. Walker:

Thank you for your letter of August 7, 2019, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NOAA) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for U.S Army Corps of Engineers (USACE) authorization of the City of Tacoma's Hood Street stormwater project. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

The enclosed document contains the biological opinion (Opinion) prepared by NOAA pursuant to section 7(a)(2) of the ESA on the effects of the proposed action. In this Opinion, NOAA concludes that the proposed action is likely to adversely affect but not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon, PS steelhead, Puget Sound/Georgia Basin (PSGB) boccacio and Yelloweye rockfish (PSGB rockfish), Southern Resident Killer Whale (SRKW).

NOAA also concludes that the proposed action is likely to adversely affect, but is not likely to result in the destruction or adverse modification of designated critical habitat for PS Chinook, PSGB rockfish, or SRKW. As required by section 7 of the ESA, NOAA has provided an incidental take statement with this Opinion.

The incidental take statement describes reasonable and prudent measures NOAA considers necessary or appropriate to minimize the impact of incidental take associated with this action, and sets forth nondiscretionary terms and conditions that the COE must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to Section 305(b) of the MSA. NOAA reviewed the likely effects of the proposed action on EFH, and concluded that the action would adversely affect designated EFH for Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document, and provided four conservation recommendations. Please review that section to ensure you comply with the EFH response requirements.

Please contact Jennifer Quan in the Central Puget Sound Branch of the Oregon/Washington Coastal Office, or by electronic mail at Jennifer.quan@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Dan Krenz, COE

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

for

Jefferson-Hood Street Stormwater project
Pierce County, Washington (COE Number: NWS-2017-595)
NOAA Consultation Number: WCRO-2019-00727

Action Agency: U.S. Army Corps of Engineers

Affected Species and Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound (PS)	Threatened	Yes	No	Yes	No
Steelhead (*O. mykiss*) PS	Threatened	Yes	No	N/A	N/A
PSGB Yelloweye rockfish	Endangered	Yes	No	Yes	No
PSGB boccacio rockfish	Endangered	Yes	No	Yes	No
Southern Resident Killer Whale (SRKW)	Threatened	Yes	No	Yes	No

N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

Affected Essential Fish Habitat (EFH) and NMFS' Determinations:

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Highly migratory species	Yes	Yes
Pacific Coast groundfish	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

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

Date: September 28, 2020

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LIST OF ACRONYMS

ACZA – Ammoniacal Copper Zinc Arsenate
BMP – Best Management Practices
CFR – Code of Federal Regulations
DIP – Demographically Independent Population
DO – Dissolved Oxygen
DPS – Distinct Population Segment
DSAY – Discounted Service Acre Years
DQA – Data Quality Act
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
HEA – Habitat Equivalency Analysis
HPA – Hydraulic Project Approval
HUC – Hydrologic Unit Code
Hz – Hertz (or cycles per second)
ITS – Incidental Take Statement
JARPA – Joint Aquatic Resource Permit Application Form
mg/l – Milligram per Liter
mg/kg – Milligram per Kilogram
MHHW – Mean Higher High Water
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NHMV – Nearshore Habitat Model Valuation
NMFS – National Marine Fisheries Service
NOAA- National Oceanic and Atmospheric Administration
NPDES – National Pollutant Discharge Elimination System
OWCO – Oregon Washington Coastal Office
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Primary Biological Feature
PCB – Polychlorinated Biphenyl
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PSGB or PS/GB – Puget Sound Georgia Basin
PS – Puget Sound
PSSTRT – Puget Sound Steelhead Technical Recovery Team
PSTRT – Puget Sound Technical Recovery Team
PTS – Permanent Threshold Shift
RL – Received Level
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SL – Source Level
TTS – Temporary Threshold Shift

USACE - US Army Corps of Engineers
VSP – Viable Salmonid Population
WCR – Westcoast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology

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

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at the Oregon Washington Coastal Office.

1.2 Consultation History

On February 1, 2019, NOAA received a letter from the US Army Corps of Engineers (USACE) requesting informal consultation for the proposed action. The request included the USACE's Memorandum for the Services (MFS), and Biological Assessment (BA) for the proposed action and project drawings.

On June 4, 2019, NOAA informed the USACE that we could not concur with their determination that the proposed action "may affect and is not likely to adversely affect" listed species and critical habitat. NOAA also requested additional information on the proposed action. The Corps provided a partial list of the requested information and they requested formal consultation.

A meeting was held with on June 20, 2019, with the applicant, USACE staff, City of Tacoma Parks department staff, and NMFS staff. The meeting was primarily held to provide technical assistance to the applicant regarding ESA and EFH consultations. NMFS staff informed the applicant that existing and planned stormwater management of the Tacoma outfalls likely have adverse impacts on ESA-listed species and their designated critical habitats. The City agreed to work with NMFS to develop a better understanding of what the City is doing and could do to further reduce its adverse effects on listed species and habitats.

On August 12, 2019 the USACE requested formal consultation for the project and provided a partial response to some of the requested additional information. The applicant requested a follow up meeting to discuss the partial response and the remainder of the additional information needed to initiate formal consolation. NMFS declined to initiate at that time because data was insufficient to conduct a full analysis.

The follow up meeting was held with City of Tacoma staff, the USACE, and NMFS on September 4, 2019. The purpose of this meeting was to assist the city staff with the request for additional information regarding the contaminants identified within the city's stormwater. At this meeting NMFS confirmed that the proposed action would result in the discharge of additional (increased amount) of stormwater into designated critical habitat and determined that an effects analysis would have to be carried out for that pathway. NMFS staff clarified that the applicant could either provide their own exposure and effect data relevant to that analysis (site specific data) or NMFS could make assumptions based on the best scientific and commercial data available from similarly contaminated stormwater. The applicant staff and their consultant requested time to determine feasibility of gathering the site specific information.

The USACE sent a project modification request on September 9, 2019, modifying the proposed work window and construction parameters for a coffer dam. The new proposed work window would be August 16 - February 15 with forage fish surveys required for work conducted between September 30 and February 15.

On September 17, 2019, the USACE provided another partial response to the requested additional information (Floyd-Snider 2018) and re-submitted their request for formal consultation. The response included a single toxicity study of stormwater effects on rainbow trout. The applicant and the USACE notified NMFS that this one study was the limit of the information they were willing to provide and requested that NMFS proceed with consultation and the effects analysis on stormwater without the site specific data. NMFS declined to initiate the consultation at that time because it needed to assemble best available commercial and scientific data.

A conference call was held on February 19, 2020, with the applicant, the USACE and NMFS staff. The phone call included a description of the water quality analysis and what information NMFS would be using to conduct the analysis.

An in-person follow-up meeting was held on March 5, 2020. The purpose of the meeting was to discuss the ongoing water quality analysis and come to agreement on water quality monitoring and treatment actions. NMFS's initial understanding and analysis of the proposed action was limited to the discharge of effluent that would meet state water quality standards. The city was informed that part of the draft analysis included components of the Oregon Toxics Biological Opinion (NMFS 2008/00148) that analyzed the effects of contaminant levels similar to the WA state water quality standards. The applicant advised NMFS that within the bounds of their permit, that there are events when the effluent from the city outfalls exceed state water quality criteria and requested that NMFS's analysis not limit potential future concentrations of contaminant discharges to state water quality criteria. In addition, NMFS was provided and has since then conducted an analysis based on contaminant levels identified in historic discharges from City of Tacoma outfall 230 (Appendix C).

During the March 5 meeting, stormwater management system maintenance and enhancements were also discussed. During the meeting the city leadership proposed stormwater pipe cleaning, filtration upgrades, and increased street cleaning to reduce potential future adverse effects to habitat and species. The specifics of the city's proposal and project modification were delivered to NMFS on March 24, 2020.

The effects on features of critical habitat resulting from the installation of the new out fall was also discussed at the March 5, 2020 meeting, as well the need for habitat offsets. The city staff and the Corps requested, on March 5, 2020 copies of the Habitat Equivalency Analysis (HEA) that NMFS had drafted. Drafts of the HEA were provided to both parties on March 16, 2020.

A conference call with the applicant, their consultant, and the USACE was held on April 2, 2020, to discuss the HEA. NMFS presented multiple options for the city to offset the effects of the new structure including; pile removal, rubble removal, bulkhead removal. The city staff agreed to evaluate the options presented and provide NMFS with an updated habitat mitigation plan in order to include components in the proposed action that would offset impacts of other aspects of the proposed action. During the conference call the USACE staff informed NMFS that they had originally evaluated, per the Clean Water Act Section 404 authorities, the mitigation needs of the applicant's project on a "square foot." Subsequently the USACE' staff informed NMFS that that the USACE had determined that habitat offsets requested by NMFS was beyond the USACE Section 404 purview and requested that NMFS remove requested habitat offsets relative to the HEA outputs that had been developed through the consultation process. Per the ESA authorities, which are distinct from the USACE authorities, NMFS continued its analysis of the effects of related to loss of Puget Sound Chinook critical habitat, and has identified measures to minimize such impacts. NMFS initiated formal consultation on April 3, 2020.

A draft of the proposed action, Reasonable and Prudent Measures, and Terms and Conditions was sent to the USACE on July 22, 2020. The USACE responded with comments and requested project modifications on July 27, 2020. The USACE followed up with additional comments and questions on August 3, 2020. NMFS responded to the USACE on August 6, 2020. On August 7, 2020, the USACE and the applicant submitted another set of comments and questions.

A second draft of the Terms and Conditions with the newly agreed upon language was sent to the USACE on September 8, 2020. To clarify and coordinate updated language, a conference call was held on September 10, 2020 between NMFS and the applicant to discuss the monitoring requirements. At the conclusion of the conference call both NMFS and the applicant agreed to the term and condition that monitoring of the effluent would be occur annually from October 1 – September 30 and would include at least 7 sampling events.

This Opinion and MSA consultation are based on the review of the information and project drawings identified above. The Opinion also relies on recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS steelhead; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited). A complete record of the combined consultation document is on file at the Oregon Washington Coastal Office (OWCO) in Lacey, Washington.

1.3 Proposed Action

"Action" under the ESA means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). "Federal action" under the MSA means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The USACE is to authorize, per their Clean Water Act regulatory permitting authorities, construction of a new stormwater outfall. To help relieve the burden on the existing storm system, the City seeks to construct a new large-diameter interceptor to collect and convey existing stormwater flows to a new 60-inch stormwater outfall into the Thea Foss Waterway. The existing stormwater system does not have sufficient capacity to convey runoff generated during significant storm events occurring in the downtown area. This project is intended to help reduce current surface water flooding in this region of the City, which will greatly reduce the instances of damage to properties and the threat to public health and safety. Increased amounts of stormwater discharge of stormwater into the Thea Foss Waterway will be through a new outfall constructed at 1147 Dock Street approximately 600 feet (ft) to the north of existing "Outfall 230." Section 2.3.1 of the USACE's Biological Assessment (BA) describes this in detail, and has since been portrayed by City of Tacoma staff as 38 percent increase of effluent per storm event over the existing discharge flow rate. This section of the BA is incorporated here by reference.

The new outfall conveying stormwater runoff to the Thea Foss Waterway will be pre-cast concrete and extend approximately 31 ft waterward from the MHHW elevation of the waterway. The outfall will be installed near the mean lower low water (MLLW) elevation (approximately 11.79 ft below MHHW). The stormwater is exempt from flow control requirements because the stormwater will be discharging to the marine waters of Puget Sound, where the receiving water body is so large that entering volume is not a concern. To minimize the potential for erosion and to slow the velocity of the stormwater flows entering the waterway, the outfall will be built with a concrete splash pad, flow dissipation blocks, and wing-walls. The results of preliminary hydraulic modeling indicate that the splash pad will be approximately 10 ft long by 14 ft wide. The wing-walls will be approximately 10 ft long by 10 ft high. The dimensions of the splash pad and wing-walls are similar to another existing structure, OF230, and designed in accordance with the City's 2016 Stormwater Management Manual (Tacoma 2016). The excavation around the outfall structure will be backfilled with aggregate rock according to the Thea Foss and Wheeler-Osgood Waterways Slope Area Maintenance Plan (Tacoma City of and Floyd Snider 2007), and overlain with 2- to 6-inch-diameter streambed cobbles.

The City also proposed to enhance the shoreline habitat by removing concrete debris from the shoreline and use of streambed cobbles and large woody debris (LWD). Existing miscellaneous debris and concrete will then be removed from the surface of the upper intertidal zone from MHHW down to MLLW. Material will be removed using a hydraulic excavator and hand tools (removed debris and concrete will be taken offsite and recycled or disposed). Clean streambed cobbles (4 to 6 inches) will be placed to a depth of 6 to 12 inches along the entire length of the shoreline to enhance the substrate similar to the habitat enhancement that was recently completed at Point Defiance (refer to Appendix B Site Photographs). Limited regrading of the slope in accordance with the Slope Area Maintenance Plan will occur, as needed, to create shallow benches (1 to 2 ft belowgrade) where LWD can be anchored and streambed cobbles secured to the slope. LWD will be kept in place using an auger anchor system. LWD will be fixed to the anchors using steel cables. Habitat enhancement activities are anticipated to take approximately 7 to 9 days to complete and will be installed when the tide is low enough that construction can be accomplished in the dry without any in-water work.

A complete description of the proposed action can be found in Section 2 of the BA and is incorporated in this Opinion by reference.

Project construction activities, listed in the approximate anticipated construction sequence, include:

1. Temporary Erosion and Sedimentation Control (TESC) Best Management Practices (BMPs): Specific TESC/BMPs will be employed at the outfall construction site in accordance with Thea Foss and Wheeler-Osgood Waterways Slope Area Maintenance Plan (Tacoma City of and Floyd Snider 2007), the approved TESC plans, and the Construction Stormwater General Permit (CSGP), and in accordance with any other approved permit conditions. Soil and groundwater that is excavated from the outfall site will be managed according to a Contaminated Materials Management Plan (CMMP) that will be reviewed by Ecology and the EPA.
2. Clearing and Grubbing: The outfall construction will require the removal of some existing shrub and herbaceous vegetation and disturbance of bare ground at the site; vegetation is dominated by invasive shrubs and grasses. There will be limited removal of vegetation within the 100-year floodplain.
3. Isolation of Outfall Work Area: Prior to beginning installation of the outfall, a temporary outfall construction work area (outfall work area), comprised of 3- or 4-foot interlocking sheet pile, approximately 30 to 40 ft long, will be installed to a minimum of 10 ft below the existing ground surface. To isolate potential impacts to water quality during the installation of the outfall work area, an absorbent boom will be installed in the waterway adjacent to the site to contain any turbidity that may be created during installation of the sheet pile.
4. Pile Installation: 30 sheet piles will be installed using a combination of impact and vibratory pile driving. The sheet piles will be installed using vibratory and impact-hammering methods. The vibratory and/or impact-hammer will be suspended from a wheel- or track-mounted hydraulic crane operating from the upland of the property above the shoreline. The dimensions of the outfall work area will be approximately 30 f. by 20 ft Once installed, the waterward (eastern) end of the temporary work area will extend horizontally no more than 31 ft from the line of MHHW and no closer than 7.5 ft from the 1147 Dock Street parcel boundary with State of Washington property. The waterward end of the outfall work area will extend to an elevation of about -8 ft NGDV29 (-2 ft MLLW). All mechanized equipment used to install sheet pile (and the outfall) will be operated from the upland portion of the 1147 Dock Street property above the shoreline.

5. Outfall Construction: Construction of the outfall work area is anticipated to take approximately 18 to 21 days and will be installed within the 100-year floodplain when the tide is low enough that all construction work can be adequately completed in the dry without any in-water work. An initial examination of tides for the Thea Foss Waterway during the anticipated outfall construction period show several consecutive days of favorable daytime tides to install the sheet pile without any in-water work (NOAA 2018).

6. Installation of Outfall Structure: Once the outfall work area is isolated from the waterway it will be dewatered and construction of the outfall and the conveyance pipeline upgradient of the outfall can begin. Removal of material from and dewatering of the outfall work area will be completed in accordance with the CMMP, the CSGP, and any other permit conditions. Approximately 140 cubic feet (cf) of fill and aggregate is expected to be removed from the outfall work area prior to the installation of the outfall. The outfall structure will be made of pre-cast concrete and will be constructed with a splash pad (apron) and wing-walls to prevent scour. The approximate dimensions of the outfall structure are expected to be 10 ft high, 10 ft long, and 14 ft wide. Subgrade aggregate will be installed under the outfall apron to prevent erosion according to the specifications outlined in the Slope Area Maintenance Plan. The outfall structure will be installed using a wheel- or track-mounted hydraulic crane operating from the upland, above the shoreline.

7. Removal of Outfall Work Area: Once the outfall has been installed and the work area backfilled to existing grades in accordance with the Slope Area Maintenance Plan, sheet pile from the temporary work area will be removed by extracting them from the 100-year floodplain with a vibratory hammer suspended from a wheel- or track-mounted hydraulic crane operating from the shoreline. The sheet pile directly beneath the excavation trench, where the conveyance pipeline will be attached to the outfall structure, will be cut and left in place to facilitate the connection of the conveyance pipeline to the outfall. The sheet pile that are cut and left in place will act as a permanent barrier to contain groundwater in the upland excavation trench that may otherwise migrate along the trench into the waterway over time. There will be no sediment, soil, or groundwater released into the waterway during construction of the outfall. The extracted sheet pile will be removed when the tide is low enough so that all construction work for this element of the project can be accomplished in the dry without in-water work. An initial examination of tides for the Thea Foss Waterway during the anticipated deconstruction period show several consecutive days of favorable daytime tides (NOAA 2018). Removal of the sheet pile is anticipated to take approximately 24 hours cumulatively.

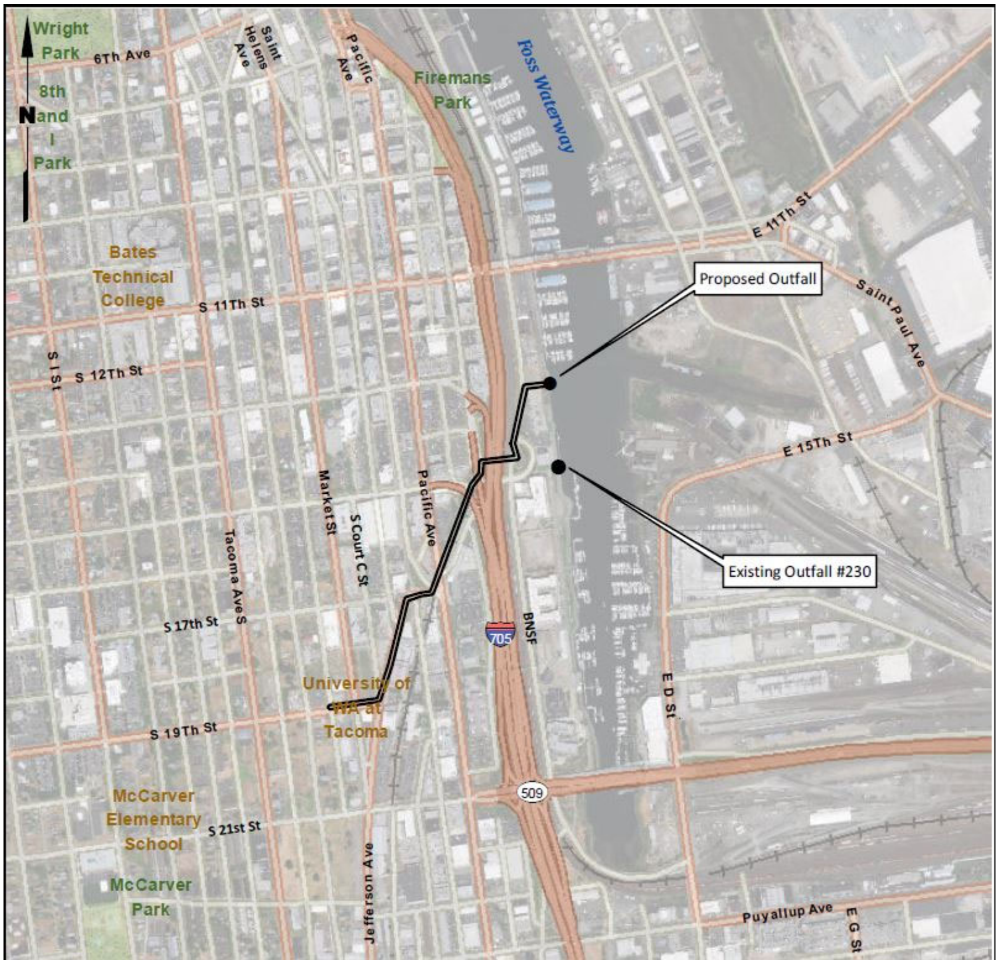

Figure 1. Google satellite photographs of the Foss waterway with location of existing and proposed new outfalls identified. Pathway of the new conveyance system is denoted as a black line.

To compensate for the long-term loss of critical habitat from the complete coverage by the stormwater outfall structure the applicant proposes to provide the following habitat enhancement (BA section 2.3):

- Once the sheet pile is extracted or cut, the outfall work area and utility easement will be graded and backfilled according to the Slope Area Maintenance Plan.
- Prior to beginning the habitat enhancement at the site, the absorbent boom will be extended in the waterway along the entire length of the shoreline to isolate turbidity and potential impacts to water quality that may occur during enhancement activities.
- Existing miscellaneous debris and concrete will then be removed from the surface of the upper intertidal zone from MHHW down to MLLW. Material will be removed using a hydraulic excavator and hand tools (removed debris and concrete will be taken offsite and recycled or disposed).
- Clean streambed cobbles (4 to 6 inches) will be placed to a depth of 6 to 12 inches along the entire length of the shoreline.

- Limited regrading of the slope in accordance with the Slope Area Maintenance Plan will occur, as needed, to create shallow benches (1 to 2 ft below grade) where LWD will be anchored parallel to the shoreline and streambed cobbles secured to the slope.
- LWD will be kept in place using an auger anchor system. LWD will be fixed to the anchors using steel cables.
- Habitat enhancement activities are anticipated to take approximately 7 to 9 days to complete and will be installed when the tide is low enough that construction can be accomplished in the dry without any in-water work.

Minimization Measures

To reduce the long term reduction to the quality of critical habitat from the input of polluted stormwater out of the outfall structure the applicant proposes to provide the following stormwater treatment and conveyance system maintenance:

1. Once Ecology approves a new bioretention media mix for stormwater treatment, the City will evaluate replacing the media in the existing bioretention facilities in the Outfall 230 Basin (Pacific Avenue and Prairie Line Trail Facilities). One recently completed study identified an alternative bioretention media blend that achieves solids, metals, and phosphorus treatment objectives, and recommends that Ecology adopt a new blend for bioretention facilities that drain to waterbodies that have an identified limit for phosphorus. Ecology's stormwater management manuals describe a default 60/40 bioretention soil mix (BSM) and list soil specifications for designers to create a custom filtration mix. In this study, collaborators from municipalities, academia, and the private sector developed and alternative BSM blends that do not leach phosphorus.

2. The City will replace the 226 cartridges of the Ferry Street Facility (current media: CONTECH Engineered Solutions Stormwater Management StormFilter®, basic treatment) with CONTECH Engineered Solutions Stormwater Management StormFilter® with MetalRx™ media approved for Enhanced Treatment Performance. If the MetalRx™ media meets or exceeds the water quality design flowrate for the facility, the city will replace the media with MetalRx™ media when the facility is maintained.

3. To ensure compliance with local water quality standards and state law the applicant will conduct water quality monitoring of the effluent leaving the outfall pipe and respond to monitoring results accordingly. The city's proposed monitoring plan is outlined in Appendix A.

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

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

Table 1. ESA listed species and designated critical habitat likely affected by the action

Species	Status	Listing	Listing Date	Critical Habitat Designation	Designation Date
Puget Sound Chinook	Threatened	64 FR 14308	3/24/1999	50 FR 52630	9/2/2005
Puget Sound Steelhead	Threatened	72 FR 26722	6/11/2007	81 FR 9252	2/24/2016
Puget Sound- Georgia Basin Bocaccio Rockfish	Endangered	75 FR 22276 (updated with 79 FR 20802)	4/28/2010	79 FR 68042	2/11/2015
Puget Sound-Georgia Basin yelloweye Rockfish	Threatened	77 FR 22276 (updated with 79 FR 20802)	4/28/2010	79 FR 68042	2/11/2015
Southern Resident Killer Whales	Endangered	70 FR 69903 (updated with 79 FR 20802)	11/18/2005	71 FR 69054	11/19/2006

LAA = likely to adversely affect. NLAA = not likely to adversely affect. N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

2.1 Analytical Approach

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

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

The designation(s) of critical habitat for the Puget Sound fish species and SRKW use the term primary constituent element (PCE). The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or to cause the destruction or adverse modification of designated critical habitat:

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

In addition, to assess impacts associated with the loss of the critical habitat, NMFS evaluated the project’s proposed action using a Habitat Equivalency Analysis (HEA). Ecological equivalency that forms the basis of HEA is a concept that uses a common currency 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 are fully offset by the services gained from a conservation activity.

2.2 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).

As described, the discharge of contaminated stormwater will be the project-related stressor with the greatest range of effect. Based on the proposed action’s effects on water quality, the action area includes the waters and substrates of the Thea-Foss Waterway and out into the mouth of

Commencement Bay, 3.5 miles northwest from the construction site. All other project-related effects would be undetectable beyond that range.

We determined the extent of action area based on the likelihood that some of the inorganic compounds and heavy metals from the increased discharge from the larger stormwater outfall will likely still be present in the water column as they are dispersed through Commencement Bay. Upon reaching the connection point to the greater Puget Sound area any contaminants that have been be sequestered may be pushed north or south depending on the Tacoma Narrow's currents and will likely be further diluted and eventually sequestered and at this point it would be difficult to detect physical, chemical or biotic effects directly related to the proposed action. As such, we will limit the action area to Commencement Bay.

This action area overlaps with the geographic ranges and boundaries of the ESA-listed species and designated critical habitat identified earlier in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon.

2.3 Range-wide Status of the Species and Critical Habitat

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

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the action area and are considered in this Opinion. More detailed information on the biology, habitat, and conservation status and trend of these listed resources can be found in the listing regulations and critical habitat designations published in the Federal Register and in the recovery plans and other sources at: http://www.nmfs.noaa.gov/pr/species/fish/, and are incorporated here by reference.

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

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; Abatzoglou et al. 2014; Kunkel et al. 2013). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014).

Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2013; Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015 this resulted in 3.5-5.3ºC increases in Columbia Basin streams and a peak temperature of 26ºC in the Willamette (NWFSC 2015). Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009).

Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Mantua et al. 2010; Isaak et al. 2012). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic food webs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Winder and Schindler 2004, Raymondi et al. 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Wainwright & Weitkamp 2013; Raymondi et al. 2013).

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

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

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. A 38 percent to 109 percent increase in acidity is projected by the end of this century in all but the most stringent CO_2 mitigation scenarios and is essentially irreversible over a time scale of centuries (IPCC 2014). Regional factors appear to be amplifying acidification in Northwest ocean waters, which is occurring earlier and more acutely than in other regions and is already impacting important local marine species (Barton et al. 2012, Feely et al. 2012). Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012, Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011, Reeder et al. 2013). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel *et al.* 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor Coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011, Reeder et al. 2013).

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

2.3.1 Status of the Species

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

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

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits (McElhany et al. 2000).

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

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

For species with multiple populations, once the biological status of a species' populations has been determined, we assess the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany, 2000). Additional information is available at NOAA's West Coast Region website; http://www.westcoast.fisheries.noaa.gov/).

Puget Sound Chinook salmon.

The Puget Sound Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160). We adopted the recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (Shared Strategy for Puget Sound 2007) and a supplement by NMFS (2006). The recovery plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus *et al.* 2002). The PSTRT's biological recovery criteria will be met when all of the following conditions are achieved:

- The viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured;
- Two to four Chinook salmon populations in each of the five biogeographical regions of the ESU (Table 6) achieve viability, depending on the historical biological characteristics and acceptable risk levels for populations within each region;
- At least one population from each major genetic and life history group historically present within each of the five biogeographical regions is viable;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario; Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and
- Populations that do not meet the viability criteria for all VSP parameters are sustained to provide ecological functions and preserve options for ESU recovery.

Spatial Structure and Diversity. The Puget Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2015). The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPG), that are based on similarities in hydrographic, biogeographic, and geologic characteristics (Table 4).

Between 1990 and 2014, the proportion of natural-origin spawners has trended downward across the ESU, with the Whidbey Basin the only MPG with consistently high fractions of natural-origin spawner abundance. All other MPG have either variable or declining spawning populations with high proportions of hatchery-origin spawners (NWFSC 2015).Overall, the new information on abundance, productivity, spatial structure and diversity since the 2010 status review supports no change in the biological risk category (NWFSC 2015).

Table 2. Extant PS Chinook salmon populations in each biogeographic region (PSTRT 2002, NWFSC 2015)

Biogeographic Region	Population (Watershed)
Strait of Georgia	North Fork Nooksack River
	South Fork Nooksack River
Strait of Juan de Fuca	Elwha River
	Dungeness River
Hood Canal	Skokomish River
	Mid Hood Canal Rivers
Whidbey Basin	Skykomish River
	Snoqualmie River
	North Fork Stillaguamish River
	South Fork Stillaguamish River
	Upper Skagit River
	Lower Skagit River
	Upper Sauk River
	Lower Sauk River
	Suiattle River
	Upper Cascade River
Central/South Puget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

Abundance and Productivity. Available data on total abundance since 1980 indicate that although abundance trends have fluctuated between positive and negative for individual populations, there are widespread negative trends in natural-origin Chinook salmon spawner abundance across the ESU (NWFSC 2015). Productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Available data now shows that most populations have declined in abundance over the past 7 to 10 years. Further, escapement levels for all populations remain well below the TRT planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the TRT as consistent with recovery (NWFSC 2015).

Washington Dept. of Fish and Wildlife maintain annual abundance observances indexing for individual runs of Puget Sound Chinook salmon stock inventory (SaSI). These counts and estimates are made on the bases of fish in system at post-harvest levels. The most recent estimates for abundance 2015-2017 put natural spawner abundance at 26,904 returners and hatchery produced spawners at 26,617 individuals (SaSI 2017).

Limiting Factors. Limiting factors for this species include:

- Degraded floodplain and in-river channel structure
- Degraded estuarine conditions and loss of estuarine habitat
- Riparian area degradation and loss of in-river large woody debris

- Excessive fine-grained sediment in spawning gravel
- Degraded water quality and temperature
- Degraded nearshore conditions
- Impaired passage for migrating fish
- Altered flow regime

Even though different life history forms have to date been studied most extensively in Skagit River Chinook salmon, Beamer et al. (2005) assume that they naturally occur in other populations, too. Further, Beamer et al. (2005) assume that the distribution within a population will depend upon environmental conditions. For example, the large number of fry migrants in the Skagit can be interpreted as a response to limited delta habitat. In the action area, salmonid fork lengths generally increased for each species' cohort, as a consequence of seasonal growth after outmigration from local watersheds, from January through September. In 2016 outmigrating chinook fork length averaged between 80 and 250 millimeters (Figure 2). Chum average fork length averaged between 35 and 125 millimeters (Frierson et al. 2017).

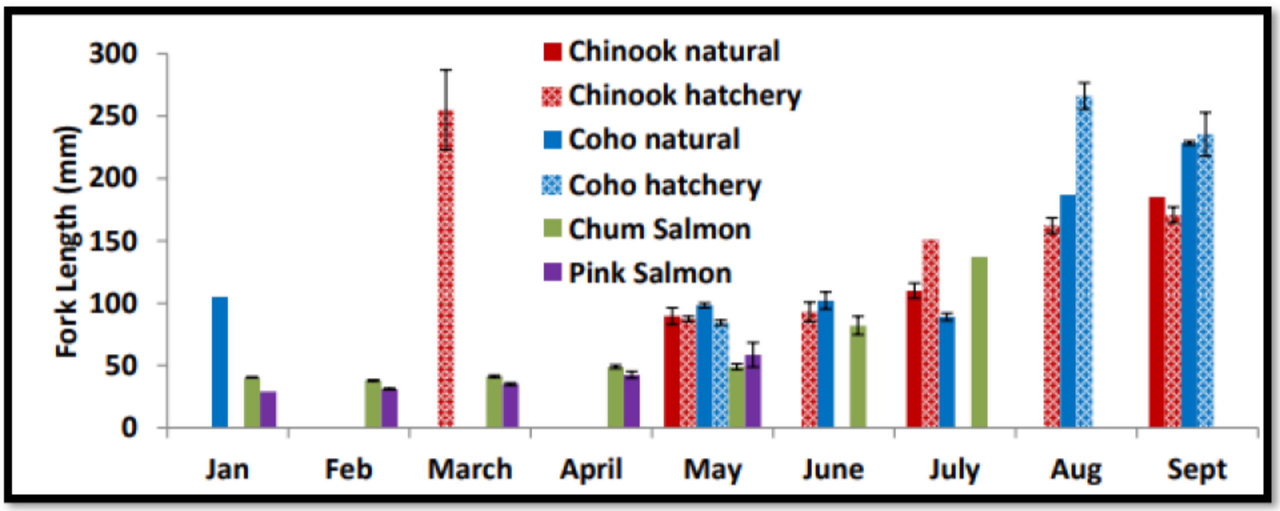

Figure 2. Mean for Length for Juvenile Salmonid Species in the Action Area, 2016

Rockfish.

NMFS adopted a recovery plan for both PS/GB bocaccio and yelloweye rockfish in 2017. Extinction risk factors identified in the plan include loss of nearshore habitat.

There are no estimates of historic or present-day abundance of yelloweye rockfish, or bocaccio across the full DPSs area. In 2013, the Washington State Department of Fish and Wildlife (WDFW) published abundance estimates from a remotely operated vehicle survey conducted in 2008 in the San Juan Island area (Pacunski et al. 2013). This survey was conducted exclusively within rocky habitats and represents the best available abundance estimates to date for one basin of the DPS. The survey produced estimates of 47,407 (25 percent variance) yelloweye rockfish, and 4,606 (100 percent variance) bocaccio in the San Juan area (Tonnes et al., 2016).

Further, data suggest that total rockfish declined at a rate of 3.1 to 3.8 percent per year from 1977 to 2014 or a 69 to 76 percent total decline over that period. The three listed species declined over-proportional compared to the total rockfish assemblage. Therefore, long-term population growth rate for the listed species was likely even lower (more negative) than that for total rockfish. Finally, there is little to no evidence of recent recovery of total rockfish abundance to recent protective measures.

Mature females of each listed species produce from several thousand to over a million eggs annually (Love et al., 2002). In rockfish the number of embryos produced by the female increases with size. For example, female copper rockfish that are 20 cm in length produce 5,000 eggs while a female 50 cm in length may produce 700,000 eggs (Palsson, 2009). These specific observations come from other rockfish, not the two listed species. However, the generality of maternal effects in Sebastes suggests that some level of age or size influence on reproduction is likely for all species.

Status of PS/GB Bocaccio

The PS/GB bocaccio distinct population segment (DPS) was listed as endangered on April 28, 2010 (75 FR 22276). In April 2016, we completed a 5-year status review that recommended the DPS retain its endangered classification (Tonnes *et al*. 2016), and we released a recovery plan in October 2017 (NMFS 2017b). Though PS/GB bocaccio were never a predominant segment of the multi-species rockfish population within the Puget Sound/Georgia Basin, their present-day abundance is likely a fraction of their pre-contemporary fishery abundance. Most PS/GB bocaccio within the DPS may have been historically spatially limited to several basins within the DPS. They were apparently historically most abundant in the Central and South Sound with no documented occurrences in the San Juan Basin until 2008. The apparent reduction of populations of PS/GB bocaccio in the Main Basin[1] and South Sound represents a further reduction in the historically spatially limited distribution of PS/GB bocaccio, and adds significant risk to the viability of the DPS.

The VSP criteria described by McElhaney *et al*. (2000), and summarized at the beginning of Section 2.2, identified spatial structure, diversity, abundance, and productivity as criteria to assess the viability of salmonid species because these criteria encompass a species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. These viability criteria reflect concepts that are well founded in conservation biology and are generally applicable to a wide variety of species because they describe demographic factors that individually and collectively provide strong indicators of extinction risk for a given species (Drake *et al*. 2010), and are therefore applied here for PS/GB bocaccio.

<u>General Life History:</u> The life history of PS/GB bocaccio includes a larval/pelagic juvenile stage that is followed by a juvenile stage, and subadult and adult stages. As with other rockfish, PS/GB bocaccio fertilize their eggs internally and the young are extruded as larvae that are about 4 to 5

[1] The U.S. portion of the Puget Sound/Georgia Basin that is occupied by yelloweye rockfish and PS/GB bocaccio can be divided into five areas, or Basins, based on the distribution of each species, geographic conditions, and habitat features. These five interconnected Basins are: (1) The San Juan/Strait of Juan de Fuca Basin, (2) Main Basin, (3) Whidbey Basin, (4) South Puget Sound, and (5) Hood Canal. 79 FR 68041: 11/13/2014

mm in length. Females produce from several thousand to over a million offspring per spawning (Love et al. 2002). The timing of larval parturition in PS/GB bocaccio is uncertain, but likely occurs within a five- to six-month window that is centered near March (Greene and Godersky 2012; NMFS 2017b; Palsson *et al*. 2009). Larvae are distributed by prevailing currents until they are large enough to actively swim toward preferred habitats, but they can pursue food within short distances immediately after birth (Tagal *et al*. 2002). Larvae are distributed throughout the water column (Weis 2004), but are also observed under free-floating algae, seagrass, and detached kelp (Love *et al*. 2002; Shaffer *et al*. 1995). Unique oceanographic conditions within Puget Sound likely result in most larvae staying within the basin where they are released rather than being broadly dispersed (Drake *et al*. 2010).

At about 3 to 6 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile PS/GB bocaccio gravitate to shallow nearshore waters where they settle and grow. Rocky or cobble substrates with kelp is most typical, but sandy areas with eelgrass are also utilized for rearing (Carr 1983; Halderson and Richards 1987; Hayden-Spear 2006; Love *et al*. 1991 & 2002; Matthews 1989; NMFS 2017b; Palsson *et al*. 2009). Young of the year rockfish may spend months or more in shallow nearshore rearing habitats before transitioning toward deeper water habitats (Palsson *et al*. 2009). As PS/GB bocaccio grow, their habitat preference shifts toward deeper waters with high relief and complex bathymetry with rock and boulder-cobble complexes (Love *et al*. 2002), but they also utilize non-rocky substrates such as sand, mud, and other unconsolidated sediments (Miller and Borton 1980; Washington 1977). Adults are most commonly found between 131 and 820 ft (40 to 250 m) (Love *et al*. 2002; Orr *et al*. 2000). The maximum age of PS/GB bocaccio is unknown, but may exceed 50 years, and they reach reproductive maturity near age six.

Spatial Structure and Diversity: The PS/GB bocaccio DPS includes all PS/GB bocaccio from inland marine waters east of the central Strait of Juan de Fuca and south of the northern Strait of Georgia. The waters of Puget Sound and Straits of Georgia can be divided into five interconnected basins that are largely hydrologically isolated from each other by relatively shallow sills (Burns 1985; Drake *et al*. 2010). The basins within US waters are: (1) San Juan, (2) Main, (4) South Sound, and (4) Hood Canal. The fifth basin consists of Canadian waters east and north of the San Juan Basin into the Straights of Georgia (Tonnes *et al*. 2016). Although most individuals of the PS/GB PS/GB bocaccio DPS are believed to remain within the basin of their origin, including larvae and pelagic juveniles, some movement between basins occurs, and the DPS is currently considered a single population.

Abundance and Productivity: The PS/GB bocaccio DPS exists at very low abundance and observations are relatively rare. No reliable range-wide historical or contemporary population estimates are available for the PS/GB bocaccio DPS. It is believed that prior to contemporary fishery removals, each of the major PS/GB basins likely hosted relatively large, though unevenly distributed, populations of PS/GB bocaccio. They were likely most common within the South Sound and Main Basin, but were never a predominant segment of the total rockfish abundance within the region (Drake *et al*. 2010). The best available information indicates that between 1965 and 2007, total rockfish populations have declined by about 70 percent in the Puget Sound region, and that PS/GB bocaccio have declined by an even greater extent (Drake *et al*. 2010; Tonnes *et al*. 2016; NMFS 2017b).
Limiting Factors: Factors limiting recovery for PS/GB PS/GB bocaccio include:

- Fisheries Removals (commercial and recreational bycatch)
- Derelict fishing gear in nearshore and deep-water environments
- Degraded water quality (chemical contamination, hypoxia, nutrients)
- Climate change
- Habitat disruption

Status of PSGB Yelloweye Rockfish

Spatial Structure PS/GB Yelloweye rockfish occupy the waters of the Pacific coast from California to Alaska. Yelloweye rockfish in the waters of the Puget Sound/Georgia Basin were determined to be a Distinct Population Segment (DPS) (75 Fed. Reg. 22276). The Puget Sound/Georgia Basin DPS of yelloweye rockfish was listed as "threatened" under the ESA on April 28, 2010 (75 Fed. Reg. 22276). The DPSs include all yelloweye rockfish a found in waters of Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca east of Victoria Sill. Critical habitat was designated for all species of listed rockfish in 2014 under section 4(a)(3)(A) of the ESA (79 Fed. Reg. 68041, November 13, 2014).

Diversity New collection and analysis of PS/GB yelloweye rockfish tissue samples reveal significant genetic differentiation between the inland (DPS) and coastal samples. These new data are consistent with and further support the existence of a population of Puget Sound/Georgia Basin yelloweye rockfish that is discrete from coastal populations (Ford 2015; NMFS 2016). In addition, yelloweye rockfish from Hood Canal were genetically differentiated from other Puget Sound/Georgia Basin fish indicating a previously unknown degree of population differentiation within the DPS (Ford 2015; NMFS 2016). Other genetic analysis has found that yelloweye rockfish in the Georgia Basin had the lowest molecular genetic diversity of a collection of samples along the coast (Siegle et al. 2013). Although the adaptive significance of such microsatellite diversity is unclear, it may suggest low effective population size, increased drift, and thus lower genetic diversity in the Puget Sound/Georgia Basin DPS.

Abundance Yelloweye rockfish within the Puget Sound/Georgia Basin (in U.S. waters) are very likely the most abundant within the San Juan Basin of the DPS. Yelloweye rockfish spatial structure and connectivity is threatened by the apparent reduction of fish within each of the basins of the DPS. This reduction is probably most acute within the basins of Puget Sound proper. The severe reduction of fish in these basins may eventually result in a contraction of the DPS' range. Recent research has found evidence for two populations of yelloweye rockfish within the DPS—one in Hood Canal and one within the rest of the Puget Sound/Georgia Basin.

In Puget Sound, catches of PS/GB yelloweye rockfish have declined as a proportion of the overall rockfish catch, from Drake et al. 2010). Analysis of SCUBA surveys, recreational catch, and WDFW trawl surveys indicated total rockfish populations in the Puget Sound region are estimated to have declined between 3.1 and 3.8 percent per year for the past several decades, which corresponds to a 69 to 76 percent decline from 1977 to 2014 (Tonnes et al. 2016)

Productivity Life history traits of yelloweye rockfish and PS/GB bocaccio suggest generally low levels of inherent productivity because they are long-lived, mature slowly, and have sporadic episodes of successful reproduction (Musick 1999; Tolimieri and Levin 2005). Yelloweye rockfish productivity may also be impacted by an Allee effect. This situation arises when reproductive adults are removed from the population and remaining individuals are eventually unable to encounter mates. This process then further reduces population density and can lead to extinction. Adult PS/GB yelloweye rockfish typically occupy relatively small ranges (Love et al. 2002), and the extent to which they may move to find suitable mates is unknown. However, there is insufficient information to determine that this is currently occurring for yelloweye rockfish and further research is needed (Hutchings and Reynolds 2004).

Puget Sound Steelhead

The PS Steelhead TRT produced viability criteria, including population viability analyses (PVAs), for 20 of 32 demographically independent populations (DIPs) and three major population groups (MPGs) in the DPS (Hard 2015). It also completed a report identifying historical populations of the DPS (Myers *et al.* 2015). The DIPs are based on genetic, environmental, and life history characteristics. Populations display winter, summer, or summer/winter run timing (Myers *et al.* 2015). The TRT concludes that the DPS is currently at "very low" viability, with most of the 32 DIPs and all three MPGs at "low" viability.

The designation of the DPS as "threatened" is based upon the extinction risk of the component populations. Hard 2015, identify several criteria for the viability of the DPS, including that a minimum of 40 percent of summer-run and 40 percent of winter-run populations historically present within each of the MPGs must be considered viable using the VSP-based criteria. For a DIP to be considered viable, it must have at least an 85 percent probability of meeting the viability criteria, as calculated by Hard (2015).

<u>Spatial Structure and Diversity</u>**.** The PS steelhead DPS is the anadromous form of O. mykiss that occur in rivers, below natural barriers to migration, in northwestern Washington State that drain to Puget Sound, Hood Canal, and the Strait of Juan de Fuca between the U.S./Canada border and the Elwha River, inclusive. The DPS also includes six hatchery stocks that are considered no more than moderately diverged from their associated natural-origin counterparts: Green River natural winter-run; Hamma Hamma winter-run; White River winter-run; Dewatto River winter-run; Duckabush River winter-run; and Elwha River native winter-run (USDC 2014). Steelhead are the anadromous form of *Oncorhynchus mykiss* that occur in rivers, below natural barriers to migration, in northwestern Washington State (Ford 2011). Non-anadromous ''resident'' *O. mykiss* occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard *et al.* 2007).

DIPs can include summer steelhead only, winter steelhead only, or a combination of summer and winter run timing (*e.g.,* winter run, summer run or summer/winter run). Most DIPs have low viability criteria scores for diversity and spatial structure, largely because of extensive hatchery influence, low breeding population sizes, and freshwater habitat fragmentation or loss (Hard *et al.* 2007). In the Central and South Puget Sound and Hood Canal and Strait of Juan de Fuca MPGs, nearly all DIPs are not viable (Hard 2015). More information on PS steelhead spatial structure and diversity can be found in NMFS' technical report (Hard 2015).

Abundance and Productivity. Abundance of adult steelhead returning to nearly all Puget Sound rivers has fallen substantially since estimates began for many populations in the late 1970s and early 1980s. Smoothed trends in abundance indicate modest increases since 2009 for 13 of the 22 DIPs. Between the two most recent five-year periods (2005-2009 and 2010-2014), the geometric mean of estimated abundance increased by an average of 5.4 percent. For seven populations in the Northern Cascades MPG, the increase was 3 percent; for five populations in the Central & South Puget Sound MPG, the increase was 10 percent; and for six populations in the Hood Canal & Strait of Juan de Fuca MPG, the increase was 4.5 percent. However, several of these upward trends are not statistically different from neutral, and most populations remain small. Inspection of geometric means of total spawner abundance from 2010 to 2014 indicates that 9 of 20 populations evaluated had geometric mean abundances fewer than 250 adults and 12 of 20 had fewer than 500 adults. Between the most recent two five-year periods (2005-2009 and 2010-2014), several populations showed increases in abundance between 10 and 100 percent, but about half have remained in decline. Long-term (15-year) trends in natural spawners are predominantly negative (NWFSC 2015).

There are some signs of modest improvement in steelhead productivity since the 2011 review, at least for some populations, especially in the Hood Canal & Strait of Juan de Fuca MPG. However, these modest changes must be sustained for a longer period (at least two generations) to lend sufficient confidence to any conclusion that productivity is improving over larger scales across the DPS. Moreover, several populations are still showing dismal productivity, especially those in the Central & South Puget Sound MPG (NWFSC 2015).

Little or no data is available on summer-run populations to evaluate extinction risk or abundance trends. Because of their small population size and the complexity of monitoring fish in headwater holding areas, summer steelhead have not been broadly monitored.

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

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

- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, increasing the likelihood of gravel scour and dislocation of rearing juveniles

Southern Resident Killer Whales

The SRKW DPS, composed of J, K, and L pods, was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). A 5-year review under the ESA completed in 2016 concluded that SRKWs should remain listed as endangered and includes recent information on the population, threats, and new research results and publications (NMFS 2016). NMFS considers SRKWs to be currently among eight of the most at-risk species as part of the Species in the Spotlight initiative[2] because of their endangered status, declining population trend, and they are high priority for recovery based on conflict with human activities and recovery programs in place to address threats. The population has relatively high mortality and low reproduction unlike other resident killer whale populations that have generally been increasing since the 1970s (Carretta et al. 2019).

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

<u>Abundance, Productivity, and Trends</u>

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

Since the early 1970s, annual summer censuses in the Salish Sea using photo-identification techniques have occurred (Bigg et al. 1990; Center for Whale Research annual photographic identification catalog, 2019). The population of SRKW was at its lowest known abundance in the early 1970s following live-captures for aquaria display (n = 68). The highest recorded abundance since the 1970s was in 1995 (98 animals), though the population declined from 1995-2001 (from 98 whales in 1995 to 81 whales in 2001). The population experience a growth between 2001 and 2006 and have been generally declining since then. However, in 2014 and 2015, the SRKW population increased from 78 to 81 as a result of multiple successful pregnancies (n = 9) that occurred in 2013 and 2014. At present, the SRKW population has declined to near historically

[2] https://www.fisheries noaa.gov/resource/document/species-spotlight-priority-actions-2016-2020-southern-resident-killer-whale

low levels. As of April 2020, the population is 72 whales (one whale is missing and presumed dead since the 2019 summer census). The previously published historical estimated abundance of SRKW is 140 animals (NMFS 2008e). This estimate (~140) was generated as the number of whales killed or removed for public display in the 1960s and 1970s (summed over all years) added to the remaining population at the time the captures ended.

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

Seasonal mortality rates among Southern and Northern Resident whales may be highest during the winter and early spring, based on the numbers of animals missing from pods returning to inland waters each spring and standings data. Olesiuk et al. (2005) identified high neonate mortality that occurred outside of the summer season, and multiple new calves have been documented in winter months that have not survived the following summer season (CWR unpublished data). Stranding rates are higher in winter and spring for all killer whale forms in Washington and Oregon (Norman et al. 2004).

The NWFSC continues to evaluate changes in fecundity and mortality rates, and has updated the population viability analyses conducted for the 2004 Status Review for SRKWs and the 2011 science panel review of the effects of salmon fisheries (Krahn et al. 2004; Hilborn et al. 2012; Ward et al. 2013). According to the updated analysis, the model results now suggests a downward trend in population size projected over the next 50 years. As the model projects out over a longer time frame (50 years) there is increased uncertainty around the estimates. The downward trend is in part due to the changing age and sex structure of the population. If the population of SRKW experiences demographic rates (e.g. fecundity and mortality) that are more similar to 2016 than the recent 5-year average (2011-2016), the population will decline faster (NMFS 2016). There are several demographic factors of the SRKW population that are cause for concern, namely (1) reduced fecundity, (2) a skewed sex ratio toward male births in recent years, (3) a lack of calf production from certain components of the population (e.g. K pod), (4) a small number of adult males acting as sires (Ford et al. 2018) and (5) an overall small number of individuals in the population (review in NMFS 2016).

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

Melbourne and Hastings 2008). The larger the population size, the greater the buffer against stochastic events and genetic risks.

Population-wide distribution of lifetime reproductive success can be highly variable, such that some individuals produce more offspring than others to subsequent generations, and male variance in reproductive success can be greater than that of females (e.g. Clutton-Brock 1988; Hochachka 2006). For long-lived vertebrates such as killer whales, some females in the population might contribute less than the number of offspring required to maintain a constant population size (n = 2), while others might produce more offspring. The smaller the population, the more weight an individual's reproductive success has on the population's growth or decline (Coulson et al. 2006). For example, from 2010 through July 2019, only 15 of the 28 reproductive aged females successfully reproduced, resulting in 16 calves. There were an additional 10 documented non-viable calves, and likely more undocumented, born during this period (CWR unpubl. data). A recent study indicated pregnancy hormones (progesterone and testosterone) can be detected in SRKW feces and have indicated several miscarriages, particularly in late pregnancy (Wasser et al. 2017). The fecal hormone data have shown that up to 69 percent of the detected pregnancies do not produce a documented calf (Wasser et al. 2017). Recent aerial imagery corroborates this high rate of loss (Fearnbach and Durban unpubl. data). The congruence between the rate of loss estimates from fecal hormones and aerial photogrammetry suggests the majority of the loss is in the latter half of pregnancy when photogrammetry can detect anomalous shape after several months of gestation (Durban et al. 2016).

<u>Geographic Range and Distribution</u>

Southern Residents occur throughout the coastal waters off Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as Southeast Alaska (NMFS 2008, Hanson et al. 2013, Carretta et al. 2017) Southern Residents are highly mobile and can travel up to 86 miles (160 km) in a single day (Baird 2000, Erickson 1978), with seasonal movements likely tied to the migration of their primary prey, salmon.

During the spring, summer, and fall months, the whales spend a substantial amount of time in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound (Bigg 1982; Ford 2000; Krahn et al. 2002; Hauser et al. 2007). In general, the three pods are increasingly more present in May and June and spend a considerable amount of time in inland waters through September. Late summer and early fall movements of Southern Residents in the Georgia Basin are consistent, with strong site fidelity shown to the region as a whole and high occurrence in the San Juan Island area (Hanson and Emmons 2010, Hauser et al. 2007). All three pods generally remain in the Georgia Basin through October and make frequent trips to the outer coasts of Washington and southern Vancouver Island and are occasionally sighted as far west as Tofino and Barkley Sound (Ford 2000; Hanson and Emmons 2010, Whale Museum unpubl. data). Sightings in late fall decline as the whales shift to the outer coasts of Vancouver Island and Washington.

Although seasonal movements are generally predictable, there can be large inter-annual variability in arrival time and days present in inland waters from spring through fall, with late arrivals and fewer days present in recent years (Hanson and Emmons 2010; The Whale Museum unpubl. data). For example, K pod has had variable occurrence in June ranging from 0 days of occurrence in inland waters to over 25 days. Fewer observed days in inland waters likely indicates changes in their prey availability (i.e., abundance, distribution and accessibility). During fall and early winter, Southern Resident pods, and J pod in particular, expand their routine movements into Puget Sound, likely to take advantage of chum and Chinook salmon runs (Hanson et al. 2010, Osborne 1999).

In recent years, several sightings and acoustic detections of Southern Residents have been obtained off the Washington and Oregon coasts in the winter and spring (Hanson et al. 2010, Hanson et al. 2013, NWFSC unpubl. data). Satellite-linked tag deployments have also provided more data on the Southern Resident killer whale movements in the winter indicating that K and L pods use the coastal waters along Washington, Oregon, and California during non-summer months. Detection rates of K and L pods on the passive acoustic recorders indicate Southern Residents occur with greater frequency off the Columbia River and Westport and are most common in March (Hanson et al. 2013). J pod has also only been detected on one of seven passive acoustic recorders positioned along the outer coast (Hanson et al. 2013). The limited range of the sightings/ acoustic detections of J pod in coastal waters, the lack of coincident occurrence during the K and L pod sightings, and the results from satellite tagging in 2012–2016 (NWFSC unpubl. data) indicate J pod's limited occurrence along the outer coast and extensive occurrence in inland waters, particularly in the northern Georgia Strait.

Limiting Factors and Threats

Several factors identified in the final recovery plan for Southern Residents may be limiting recovery. These are quantity and quality of prey, toxic chemicals that accumulate in top predators, and disturbance from sound and vessels. Oil spills are also a risk factor. It is likely that multiple threats are acting together to impact the whales. Modeling exercises have attempted to identify which threats are most significant to survival and recovery (Lacy et al. 2017) and available data suggests that all of the threats are potential limiting factors (NMFS 2008).

Quantity and Quality of Prey

SRKWs have been documented to consume a variety of fish species (22 species) and one species of squid (Ford et al. 1998; Ford et al. 2000; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016), but salmon are identified as their primary prey. SRKWs are the subject of ongoing research, the majority of which has occurred in inland waters of Washington State and British Columbia, Canada during summer months and includes direct observation, scale and tissue sampling of prey remains, and fecal sampling. The diet data suggest that SRKWs are consuming mostly larger (i.e., generally age 3 and up) Chinook salmon (Ford and Ellis 2006). Chinook salmon is their primary prey despite the much lower abundance in comparison to other salmonids in some areas and during certain time periods (Ford and Ellis 2006). Factors of potential importance include the species' large size, high fat and energy content, and year-round occurrence in the SRKWs' geographic range. Chinook salmon have the highest value of total energy content compared to other salmonids because of their larger body size and higher energy density (kilocalorie/kilogram (kcal/kg)) (O'Neill et al. 2014). For example, in order for a SRKW to obtain the total energy value of one adult Chinook salmon, they would need to consume approximately 2.7 coho, 3.1 chum, 3.1 sockeye, or 6.4 pink salmon (O'Neill et al. 2014). Research suggests that SRKWs are capable of detecting, localizing, and recognizing Chinook salmon through their ability to distinguish Chinook echo structure as different from other salmon

(Au et al. 2010). The degree to which killer whales are able to or willing to switch to non-preferred prey sources (i.e., prey other than Chinook salmon) is also largely unknown, and likely variable depending on the time and location.

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

<u>May – September</u> - Scale and tissue sampling from May to September in inland waters of Washington and British Columbia, Canada indicate that the SRKW's diet consists of a high percentage of Chinook salmon (monthly proportions as high as >90 percent) (Hanson et al. 2010; Ford et al. 2016). Genetic analysis of the Hanson et al. (2010) samples from 2006-2010 indicate that when SRKW are in inland waters from May to September, they primarily consume Chinook stocks that originate from the Fraser River (80–90 percent of the diet in the Strait of Juan de Fuca and San Juan Islands; including Upper Fraser, Mid Fraser, Lower Fraser, North Thompson, South Thompson and Lower Thompson), and to a lesser extent consume stocks from Puget Sound (North and South Puget Sound) and Central British Columbia Coast and West and East Vancouver Island. This is not unexpected as all of these stocks are returning to streams proximal to these inland waters during this timeframe. Few diet samples have been collected in summer months outside of the Salish Sea.

DNA quantification methods are also used to estimate the proportion of different prey species in the diet from fecal samples (Deagle et al. 2005). Recently, Ford et al. (2016) confirmed the importance of Chinook salmon to SRKWs in the early to mid-summer months (May-August) using DNA sequencing from SRKW feces collected in inland waters of Washington and British Columbia. Salmon and steelhead made up greater than 98 percent of the inferred diet, of which almost 80 percent were Chinook salmon. Coho salmon and steelhead are also found in the diet in inland waters of Washington and British Columbia in spring and fall months when Chinook salmon are less abundant. Specifically, coho salmon contribute to over 40 percent of the diet in September in inland waters, which is evidence of prey shifting at the end of summer towards coho salmon (Ford et al. 1998; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016). Less than 3 percent each of chum salmon, sockeye salmon, and steelhead were observed in fecal DNA samples collected in the summer months (May through September) in inland waters.

<u>October – </u>December - Prey remains and fecal samples collected in U.S. inland waters during October through December indicate Chinook and chum salmon are primary contributors of the whale's diet during this time (NWFSC unpublished data). Diet data for the Strait of Georgia and coastal waters is limited.

January – April -Observations of SRKWs overlapping with salmon runs (Wiles 2004; Zamon et al. 2007) and collection of prey and fecal samples have also occurred in coastal waters in the winter and spring months. Although fewer predation events have been observed and fewer fecal samples collected in coastal waters, recent data indicate that salmon, and Chinook salmon in particular, remains an important dietary component when the SRKWs occur in outer coastal waters during these timeframes. Prior to 2013, only three prey samples for SRKW on the U.S. outer coast had been collected (Hanson et al. in prep). From 2013 to 2016, satellite tags were used to locate and follow the whales to obtain predation and fecal samples. A total of 55 samples were collected from northern California to northern Washington. Results of the 55 available prey samples indicate that, as is the case in inland waters, Chinook are the primary species detected in diet samples on the outer coast, although steelhead, chum, lingcod, and halibut were also detected in samples. Despite J pod utilizing much of the Salish Sea – including the Strait of Georgia – in winter months (Hanson et al. 2018), few diet samples have been collected in this region in winter.

The occurrence of K and L pods off the Columbia River in March suggests the importance of Columbia River spring runs of Chinook salmon in their diet (Hanson et al. 2013). Chinook genetic stock identification from samples collected in winter and spring in coastal waters from California through Washington included 12 U.S. west coast stocks, and showed that over half the Chinook salmon consumed originated in the Columbia River (Hanson et al. in prep). Columbia River, Central Valley, Puget Sound, and Fraser River Chinook salmon collectively comprised over 90 percent of the 55 diet samples collected for SRKW's in coastal areas.

As noted, most of the Chinook prey samples opportunistically collected in coastal waters were determined to have originated from the Columbia River basin, including Lower Columbia Spring, Middle Columbia Tule, and Upper Columbia Summer/Fall. In general, we would expect to find these stocks given the diet sample locations. However, the Chinook stocks included fish from as far north as the Taku River (Alaska and British Columbia stocks) and as far south as the Central Valley California.

In an effort to prioritize recovery efforts such as habitat restoration and help inform efforts to use fish hatcheries to increase the whales' prey base, NMFS and WDFW developed a report identifying Chinook salmon stocks thought to be of high importance to SRKW along the West Coast (NMFS and WDFW 2018)[3]. Scientists and managers from the U.S. and Canada reviewed the model at a workshop sponsored by the National Fish and Wildlife Foundation (NFWF), where the focus was on assisting NFWF in prioritizing funding for salmon related projects. The priority stock report was created using observations of Chinook salmon stocks found in scat and prey scale/tissue samples, and by estimating the spatial and temporal overlap with Chinook salmon stocks ranging from Southeast Alaska (SEAK) to California (CA).

Hatchery production is a significant component of the salmon prey base returning to watersheds within the range of SRKWs (Barnett-Johnson et al. 2007; NMFS 2008). The release of hatchery fish has not been identified as a threat to the survival or persistence of SRKWs and there is no evidence to suggest the whales prefer wild salmon over hatchery salmon. Increased Chinook abundance, including hatchery fish, benefit this endangered population of whales by enhancing

[3]https://www.westcoast.fisheries.noaa.gov/publications/protected_species/marine_mammals/killer_whales/recovery/srkw_priority_chinook_stocks_conceptual_model_report___list_22june2018.pdf

prey availability to SRKWs and hatchery fish often contribute significantly to the salmon stocks consumed (Hanson et al. 2010, Hanson et al. in prep). Currently, hatchery fish play a mitigation role of helping sustain Chinook salmon numbers while other, longer term, recovery actions for natural fish are underway. Although hatchery production has contributed some offset of the historical declines in the abundance of natural-origin salmon within the range of the whales, hatcheries also pose risks to natural-origin salmon populations (Nickelson et al. 1986; Ford 2002; Levin and Williams 2002; Naish et al. 2007). Healthy natural-origin salmon populations are important to the long-term maintenance of prey populations available to Southern Residents because it is uncertain whether a hatchery dominated mix of stocks is sustainable indefinitely and because hatchery fish can differ, relative to natural-origin Chinook salmon, for example, in size and hence caloric value and in availability/migration location and timing.

Nutritional Limitation and Body Condition
When prey is scarce or in low density, SRKWs likely spend more time foraging than when prey is plentiful or in high density. Increased energy expenditure and prey limitation can cause poor body condition and nutritional stress. Nutritional stress is the condition of being unable to acquire adequate energy and nutrients from prey resources and as a chronic condition, can lead to reduced body size of individuals and to lower reproductive or survival rates in a population (Trites and Donnelly 2003). During periods of nutritional stress and poor body condition, cetaceans lose adipose tissue behind the cranium, displaying a condition known as "peanut-head" in extreme cases (Pettis et al. 2004; Bradford et al. 2012; Joblon et al. 2014). Between 1994 and 2008, 13 SRKWs were observed from boats to have a pronounced "peanut-head"; and all but two subsequently died (Durban et al. 2009; Center for Whale Research unpublished data). None of the whales that died were subsequently recovered, and therefore definitive cause of death could not be identified. Both females and males across a range of ages were found in poor body condition.

Since 2008, NOAA's Southwest Fishery Science Center (SWFSC) have used aerial photogrammetry to assess the body condition and health of SRKWs, initially in collaboration with the Center for Whale Research and the Vancouver Aquarium. Aerial photogrammetry studies have provided finer resolution for detecting poor condition, even before it manifests in "peanut-head" that is observable from boats. Annual aerial surveys of the population from 2013-2017 (with exception of 2014) have detected declines in condition before the death of seven SRKWs (L52 and J8 as reported in Fearnbach et al. (2018); J14, J2, J28, J54, and J52 as reported in Durban et al. (2017)), including five of the six most recent mortalities (Trites and Rosen 2018). These data have provided evidence of a general decline in SRKW body condition since 2008, and documented members of J pod being in poorer body condition in May compared to September of the previous year (at least in 2016 and 2017) (Trites and Rosen 2018). Other pods could not be reliably photographed in both seasonal periods.

Data collected from three SRKW strandings in recent years have also contributed to our knowledge of the health of the population and the impact of the threats to which they are exposed. Transboundary partnerships have supported thorough necropsies of L112 in 2012, J32 in 2014, and L95 in 2016, which included testing for contaminant load, disease and pathogens, organ condition, and diet composition[4]. In fall 2016 another young adult male, J34, was found

[4] Reports for those necropsies are available at:
http://www.westcoast fisheries.noaa.gov/protected_species/marine_mammals/killer_whale/rpi_strandings.html

dead in the northern Georgia Strait (Carretta et al. 2019). The necropsy indicated that the whale died of blunt force trauma to the head and the source of trauma is still under investigation.

Previous scientific review investigating nutritional stress as a cause of poor body condition for SRKWs concluded "Unless a large fraction of the population experienced poor condition in a particular year, and there was ancillary information suggesting a shortage of prey in that same year, malnutrition remains only one of several possible causes of poor condition" (Hilborn et al. 2012). Body condition in whales can be influenced by a number of factors, including prey availability or limitation, increased energy demands, disease, physiological or life history status, and variability over seasons or across years. Body condition data collected to date has documented declines in condition for some animals in some pods and these occurrences have been scattered across demographic and social groups (Fearnbach et al. 2018).

It is possible that poor nutrition could contribute to mortality through a variety of mechanisms. To exhibit how this is possible, we reference studies that have demonstrated the effects of energetic stress (caused by incremental increases in energy expenditures or incremental reductions in available energy) on adult females and juveniles, which have been studied extensively (e.g., adult females: Gamel et al. (2005), Schaefer (1996), Daan et al. (1996), juveniles: Trites and Donnelly (2003)). Small, incremental increases in energy demands should have the same effect on an animal's energy budget as small, incremental reductions in available energy, such as one would expect from reductions in prey. Malnutrition and persistent or chronic stress can induce changes in immune function in mammals and may be associated with increased bacterial and viral infections, and lymphoid depletion (Mongillo et al. 2016; Neale et al. 2005; Maggini et al. 2018). Ford and Ellis (2006) report that SRKWs engage in prey sharing about 76 percent of the time. Prey sharing presumably would distribute more evenly the effects of prey limitation across individuals of the population than would otherwise be the case (i.e., if the most successful foragers did not share with other individuals).

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

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

In April 2015, NMFS hosted a 2-day SRKW health workshop to assess the causes of decreased survival and reproduction in the killer whales. Following the workshop, a list of potential action items to better understand what is causing decreased reproduction and increased mortality in this population was generated and then reviewed and prioritized to produce the Priorities Report (NMFS 2015). The report also provides prioritized opportunities to establish important baseline information on Southern Resident and reference populations to better assess negative impacts of future health risks, as well as positive impacts of mitigation strategies on Southern Resident killer whale health.

Disturbance from Vessels and Sound

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

At the time of the SRKWs' listing under the ESA, NMFS reviewed existing protections for the whales and developed recovery actions, including vessel regulations, to address the threat of vessels to SRKWs. NMFS concluded it was necessary and advisable to adopt regulations to protect SRKWs from disturbance and sound associated with vessels, to support recovery of SRKWs. Federal vessel regulations were established in 2011 to prohibit vessels from approaching SRKWs within 200 yards (182.9m) and from parking in the path of SRKWs within 400 yards (365.8m). These regulations apply to all vessels in inland waters of Washington State with exemptions to maintain safe navigation and for government vessels in the course of official duties, ships in the shipping lanes, research vessels under permit, and vessels lawfully engaged in commercial or treaty Indian fishing that are actively setting, retrieving, or closely tending fishing gear (76 FR 20870, April, 14, 2011).

In the final rule implementing these regulations, NMFS committed to reviewing the vessel regulations to evaluate effectiveness, and also to study the impact of the regulations on the viability of the local whale watch industry. In December 2017, NMFS completed a technical memorandum evaluating the effectiveness of regulations adopted in 2011 to help protect endangered SRKWs from the impacts of vessel traffic and noise (Ferrara et al. 2017). In the assessment, Ferrara et al. (2017) used five measures: education and outreach efforts, enforcement, vessel compliance, biological effectiveness, and economic impacts. For each measure, the trends and observations in the five years leading up to the regulations (2006-2010) were compared to the trends and observations in the five years following the regulations (2011-2015). The memo finds that some indicators suggested the regulations have benefited SRKWs by reducing impacts without causing economic harm to the commercial whale-watching industry or local communities, whereas some indicators suggested that vessel impacts continue and that some risks may have increased. The authors also find room for improvement in terms of increasing awareness and enforcement of the regulations, which would help improve compliance and further reduce biological impacts to the whales.

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

Oil Spills
In the Northwest, SRKWs are the most vulnerable marine mammal population to the risks imposed by an oil spill due to their small population size, strong site fidelity to areas with high oil spill risk, large group size, late reproductive maturity, low reproductive rate, and specialized diet, among other attributes (Jarvela-Rosenberger et al. 2017). Oil spills have occurred in the range of SRKWs in the past, and there is potential for spills in the future. Oil can be discharged into the marine environment in any number of ways, including shipping accidents, refineries and associated production facilities, and pipelines. Despite many improvements in spill prevention since the late 1980s, much of the region inhabited by SRKWs remains at risk from serious spills because of the heavy volume of shipping traffic and proximity to petroleum refining centers.

Repeated ingestion of petroleum hydrocarbons by killer whales likely causes adverse effects; however, long-term consequences are poorly understood. In marine mammals, acute exposure to petroleum products can cause changes in behavior and reduced activity, inflammation of the mucous membranes, lung congestion and disease, pneumonia, liver disorders, neurological damage, adrenal toxicity, reduced reproductive rates, and changes in immune function (Schwacke et al. 2013; Venn-Watson et al. 2015; de Guise et al. 2017; Kellar et al. 2017), potentially death and long-term effects on population viability (Matkin et al. 2008; Ziccardi et al. 2015). For example, 122 cetaceans stranded or were reported dead within 5 months following the Deepwater Horizon spill in the Gulf of Mexico (Ziccardi et al. 2015). An additional 785 cetaceans were found stranded from November 2010 to June 2013, which was declared an Unusual Mortality Event (Ziccardi et al. 2015). Previous PAH exposure estimates suggested SRKWs can be occasionally exposed to concerning levels (Lachmuth et al. 2011). More recently, Lundin et al. (2018) measured PAHs in whale fecal samples collected in inland waters of Washington between 2010 and 2013 and found low concentrations of the measured PAHs (<10 parts per billion (ppb), wet weight). However, PAHs were as high as 104 ppb in the first year of their study (2010) compared to the subsequent years. Although it is unclear the cause of this trend, higher levels were observed prior to the 2011 vessel regulations that increased the distance vessels could approach the whales. In addition, oil spills have the potential to adversely impact habitat and prey populations, and, therefore, may adversely affect SRKWs by reducing food availability.

2.3.2 Status of Critical Habitat

The designation of critical habitats previously used the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7214) replace this term with physical or biological features (PBF). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified primary constituent elements, physical or biological features, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

This section summarizes the status of designated critical habitat affected by the proposed action bypresenting the condition and trends of PBFs throughout the designated areas in Table 5, below. PBFs are essential to the conservation of the listed species because they support one or more of the species' life stages (*e.g.*, sites with conditions that support spawning, rearing, migration and foraging).

Salmon and Steelhead Critical Habitat

For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC_5) in terms of the conservation value they provide to each listed species they support.[5] The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHART) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NOAA Fisheries 2005). Thus, even a location that has poor quality habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (*e.g.*, one of a very few spawning areas), a unique contribution of the population it served (*e.g.*, a population at the extreme end of geographic distribution), or the fact that it serves another important role (*e.g.*, obligate area for migration to upstream spawning areas).

[5] The conservation value of a site depends upon "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" (NOAA Fisheries 2005).

Generally, critical habitat for both PS Chinook salmon and PS steelhead throughout the Puget Sound basin's freshwater areas has been degraded by numerous management activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large wood, intense urbanization, agriculture, alteration of floodplain and stream morphology (*i.e*., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors in areas of critical habitat. The PS recovery domain CHART (NOAA Fisheries 2005) determined that only a few watersheds are in good-to-excellent condition with no potential for improvement. Most HUC_5 watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or a high potential for improvement. Marine areas, despite being degraded, are ranked with high conservation value because of the critical role these areas serve for both outmigrating juveniles and returning adults. However, no PBFs are designated for steelhead.

The proposed action will predominantly affect freshwater habitat areas and also effect the estuary. The PBFs of freshwater estuarine, and marine areas are presented in (Table 3). The physical or biological features of freshwater migration corridors for adults and juveniles are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow juvenile fish to proceed downstream and reach the ocean.

Table 3. Physical and biological features of critical habitats designated for ESA-listed salmon and steelhead species. Steelhead do not have PBFs in nearshore or marine areas.

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

Puget Sound Rockfish

NMFS designated critical habitat for PS/GB yelloweye rockfish and PS/GB bocaccio on November 13, 2014 (79 FR 68042). That critical habitat includes marine waters and substrates of the US in Puget Sound east of Green Point in the Strait of Juan de Fuca. Nearshore critical habitat, designated for juvenile life stages, is defined as areas that are contiguous with the shoreline from the line of extreme high water out to a depth no greater than 98 ft (30 m) relative to mean lower low water. The PBFs of nearshore critical habitat include settlement habitats with sand, rock, and/or cobble substrates that also support kelp. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (2) Water quality and sufficient levels of dissolved oxygen (DO) to support growth, survival, reproduction, and feeding opportunities. Deepwater critical habitat is defined as areas at depths greater than 98 ft (30 m) that supports feeding opportunities and predator avoidance.

Table 7 lists the PBFs and corresponding life history events for PS/GB yelloweye rockfish and PS/GB bocaccio critical habitat.

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS/GB bocaccio, and corresponding life history events

Physical or Biological Features Site Type	Physical or Biological Features Site Attributes	Species Life History Event
Nearshore habitats with substrate that supports kelp	Prey quantity, quality, and availability Water quality and sufficient DO	Juvenile bocaccio settlement, growth, and development
Deepwater habitats with Complex bathymetry	Prey quantity, quality, and availability Water quality and sufficient DO	Juvenile yelloweye rockfish settlement, growth, and development Adult bocaccio and yelloweye rockfish growth and reproduction,

The federal register notice for the designation of rockfish critical habitat in Puget Sound notes that many forms of human activities have the potential to affect the essential features of listed rockfish species, and specifically calls out, among others, (1) Nearshore development and in-water construction (e.g., beach armoring, pier construction, jetty or harbor construction, pile driving construction, residential and commercial construction); (2) dredging and disposal of dredged material; (3) pollution and runoff (79 FR 68041;11/13/14). Water quality throughout Puget Sound is degraded by anthropogenic sources within the Sound (e.g. pollutants from vessels) as well as upstream sources (municipal, industrial, and nonpoint sources). Nearshore habitat degradation exists throughout the Puget Sound from fill and dredge to create both fastland and navigational areas for commerce, from shore hardening to protect both residential and commercial waterfront properties, and from overwater structures that enable commercial and recreational boating.

Southern Resident Killer Whale - designated and proposed
Critical habitat for the Southern Resident killer whale DPS was designated on November 29, 2006 (71 FR 69054). Critical habitat includes approximately 2,560 square miles of inland waters of Washington, and on September 19, 2019 NMFS proposed to revise the critical habitat designation for the SRKW DPS under the ESA by designating six new areas along the U.S. West Coast (84 FR 49214).The primary constituent elements (or physical and biological features) of designated critical habitat for SRKW are:

1. Water quality to support growth and development;
2. Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and
3. Passage conditions to allow for migration, resting, and foraging

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

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Puget Sound Chinook salmon	9/2/2005;70 FR 52630	Critical habitat for Puget Sound Chinook salmon includes 1,683 miles of streams, 41 square mile of lakes, and 2,182 miles of nearshore marine habitat in Puget Sounds. The Puget Sound Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.
Puget Sound steelhead	2/24/2016; 81 FR 9252	Critical habitat for Puget Sound steelhead includes 2,031 stream miles. Nearshore and offshore marine waters were not designated for this species. There are 66 watersheds within the range of this DPS. Nine watersheds received a low conservation value rating, 16 received a medium rating, and 41 received a high rating to the DPS.
Puget Sound/Georgia Basin DPS of yelloweye rockfish	11/13/2014; 79 FR68042	Critical habitat for yelloweye rockfish includes 414.1 square miles of deep water marine habitat in Puget Sound, all of which overlaps with areas designated for canary rockfish and bocaccio. No nearshore component was included in the CH listing for juvenile yelloweye rockfish as they, different from bocaccio and canary rockfish, typically are not found in intertidal waters (Love et al., 1991). Yelloweye rockfish are most frequently observed in waters deeper than 30 meters (98 ft) near the upper depth range of adults (Yamanaka et al., 2006). Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Puget Sound/Georgia Basin DPS of bocaccio	11/13/2014; 79 FR68042	Critical habitat for bocaccio includes 590.4 square miles of nearshore habitat and 414.1 square miles of deep water habitat. Critical habitat is not designated in areas outside of United States jurisdiction; therefore, although waters in Canada are part of the DPSs' ranges for all three species, critical habitat was not designated in that area. Based on the natural history of bocaccio and their habitat needs, NMFS identified two physical or biological features, essential for their conservation: 1) Deepwater sites (>30 meters) that support growth, survival, reproduction, and feeding opportunities; 2) Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge. Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.
Southern resident killer whale	11/29/2006; 71 FR 69054	Critical habitat consists of three specific marine areas of inland waters of Washington: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. These areas comprise approximately 2,560 square miles of marine habitat. Based on the natural history of the Southern Residents and their habitat needs, NMFS identified three PCEs, or physical or biological features, essential for the conservation of Southern Residents: 1) Water quality to support growth and development; 2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and 3) passage conditions to allow for migration, resting, and foraging Water quality in Puget Sound, in general, is degraded. Some pollutants in Puget Sound persist and build up in marine organisms including Southern Residents and their prey resources, despite bans in the 1970s of some harmful substances and cleanup efforts. The primary concern for direct effects on whales from water quality is oil spills, although oil spills can also have long-lasting impacts on other habitat features In regards to passage, human activities can interfere with movements of the whales and impact their passage. In particular, vessels may present obstacles to whales' passage, causing the whales to swim further and change direction more often, which can increase energy expenditure for whales and impacts foraging behavior. Reduced prey abundance, particularly Chinook salmon, is also a concern for critical habitat.
	10/17/2019; 84 FR 55530 (proposed)	The proposal would extend critical habitat for the whales along a roughly 1,000-mile swath of West Coast waters between the depths of 6.1 meters (20 ft) and 200 meters (about 650 ft). It would stretch from Cape Flattery, Washington, south to Point Sur, California, just south of Santa Cruz

2.4 Environmental Baseline

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

Historically, the Commencement Bay / Puyallup River Estuary included thousands of acres of mudflat and fringing marsh habitat. Dredge and fill programs reduced the acreage of habitat by over 90% to create waterways and adjacent uplands for commerce and industry (Simenstad. 2000). Virtually all of the early industrial, commercial, and residential facilities discharged untreated wastes directly to the waterway, some of which persisted into the 1940s and beyond. Tomlinson (1977) cites a 1943 Washington State Pollution Commission report that indicated that the Seattle Gas Plant (now Gasworks Park) discharged oily wastes so routinely that the water surface was covered and fish kills occurred in its vicinity. The report also identified raw sewage discharge into the waterway from most of the residences, commercial establishments, and all of the houseboats that lined the shoreline. Stormwater drainage has also contributed to pollutant loading. A Department of Ecology report in 1999 (WDOE 1999) evaluated water quality for metal concentrations in the three waterbodies that make up Commencement Bay (Thea Foss, Hylebos, and Blair) and found that all metals were within then applicable state and EPA water quality criteria for marine life, indicating that clean-up efforts had significantly decreased historical contamination. However, portions of Commencement Bay remain on Ecology's 303(d) list of impaired waterbodies. Within the inner bay, Thea Foss Waterway is listed for PCBs and Hylebos Waterway is listed for dieldrin, PCBs, chlorinated pesticides, dichlorodiphenyltrichloroethane (DDT), and high molecular weight polycyclic aromatic hydrocarbons (HPAH). The Blair Waterway is not on the 303(d) list, but benzene, tetrachloroethylene, and trichloroethylene levels list it under "waters of concern". Outer Commencement Bay is listed for bacteria, DO, PCBs, and Bis(2-Ethylhexyl)phthalate (USACE and Tacoma 2019).

The action area (Commencement Bay) provides migratory habitat for adult and juvenile PS Chinook salmon and PS steelhead through the Puyallup river watershed. Therefore, those fish must pass through or close to the action area twice to reproduce; first as out-migrating juveniles, then again as returning adults. Smolt-to-adult survival rates for hatchery-reared sub-yearling Chinook salmon within Puget Sound have averaged less than 1% over the past three decades (Kilduff et al. 2014). There is also evidence that loss of nearshore habitat quality may be eliminating PS Chinook salmon life history strategies that make use of nearshore areas during the early life stages. Beechie et al. (2017) found < 3 % of adults returning to the Green and Puyallup to exhibit the fry migrant life history while approximately 95 percent of their estuary habitat has been eliminated. The converse was true from the Skagit and Nooksack estuaries where ~ 50 % of the estuary remained in a natural state (Beechie et al. 2017) and 36 and 24 % of the adult population we examined returned from small fry sized fish, respectively.

The area has also been designated as critical habitat for PS Chinook salmon. Chinook salmon in turn are prey of SRKW, and a feature of SRKW critical habitat. The past and ongoing anthropogenic impacts described above have established conditions that maintain low current velocities, as well as salinity and temperature gradients that hinder migration of both juvenile and adult salmonids, and expose PS Chinook salmon and PS steelhead to high levels of predation.

The new stormwater outfall will convey stormwater that is currently discharged out of the existing outfall 230[6]. This discharge could continue without the proposed action and is not caused by the proposed action. Because the current amount of effluent and its contaminant load is not a consequence of the proposed action it is considered part of the environmental baseline. The new outfall will result in a 38% increase over the current discharge, will contribute to additional load and will be analyzed in the next section as an effect of the action. Likewise, as a result of the proposed action, the point of discharge will change. Effects resulting from the change in discharge location are also analyzed as consequences of the proposed action. Contaminant loads related to the historical discharges can be found in Appendix C.

In general, the pollutants in the existing stormwater discharge are diverse. The discharge itself comes from rainfall or snowmelt moving over and through the ground – also referred to here as "runoff." As the runoff travels along its path, it picks up and carries away natural and anthropogenic pollutants (U.S. EPA 2016b). Pollutants in stormwater discharge typically include

- Excess fertilizers, herbicides, insecticides and sediment from landscaping areas.
- Chemicals and salts from de-icing agents applied on sidewalks, driveways, and parking areas.
- Oil, grease, PAHs and other toxic chemicals from roads and parking areas used by motor vehicles.
- Bacteria and nutrients from pet wastes and faulty septic systems.
- Metals (arsenic, copper, chromium, lead, mercury, and nickel) and other pollutants from the pesticide use in landscaping, roof runoff (WDOE 2014), decay of building and other infrastructure, and as airborne particles from street and tire wear.
- Atmospheric deposition from surrounding land uses.
- Metals, PAHs, PBDEs, and phthalates from roof runoff.
- Erosion of sediment and attached pollutants due to hydromodification.

(Buckler and Granato 1999; Colman *et al.* 2001; Driscoll *et al.* 1990; Kayhanian *et al.* 2003; Van Metre *et al.* 2006).

More recently Mackenzie, et al. 2017 complied an updated review of stormwater impacts specific to Puget Sound. They found that stormwater is the most important pathway to Puget Sound for most toxic contaminants, transporting more than half of the Sound's total known toxic load (Ecology & King County 2011). During a robust Puget Sound monitoring study, toxic chemicals were detected more frequently and at higher concentrations during storm events compared with baseflow for diverse land covers, pointing to stormwater pollution (Ecology

[6] Currently no federal mechanism exists that would have resulted in the City's NPDES permit to be evaluated under ESA. Existing stormwater discharge is considered in this opinion as part of the environmental baseline and any resulting "take" from the existing stormwater is not exempted through this opinion.

2011). The Puget Sound basin has over 4,500 unnatural surface water and stormwater outfalls, 2,121 of which discharge directly into the Sound (WDNR 2015).

2.5 Effects of the Action

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

The effects of the proposed action include in this analysis are: (1) Construction activities, (2) Permanent of loss of habitat at the new outfall site, and (3) Increased stormwater discharge.

<u>Construction activities</u>

Temporarily Degraded Water Quality

Construction-related degraded quality is expected to include, despite use of sediment retention best practices, likely pulses of sediment into the water way, creating suspended sediment/turbid conditions. These conditions could be intermittent, but occur frequently over the 150 days construction period.

Areas where sediment is disturbed by in-or near water will disturb and diminish benthic prey communities. In areas where suspended sediment settles on the bottom, some smothering can occur which also disrupts the benthic communities. The speed of recovery by benthic communities is affected by several factors, including the intensity of the disturbance, with greater disturbance increasing the time to recovery (Dernie et al., 2003). Additionally, the ability of a disturbed site to recolonize is affected by whether or not adjacent benthic communities are nearby that can re-seed the affected area. Thus recovery can range from several weeks to many months.

<u>Permanent of loss of habitat loss the new outfall site</u>

Reduction in Quality, Quantity and Availability of Prey and Forage

Placement of the outfall and splash pad will completely eliminate a 140 square foot (sq. foot) area of benthic habitat. These structures will reduce the abundance of prey organisms in the action areaand also affects habitat complexity by reducing aquatic vegetation and phytoplankton abundance. The pipe and splash pad totaling 140 (sq. foot) of benthos will no longer support benthic aquatic vegetation, and macroinvertebrates (Cullilan, 2003). These anticipated effects will persist as long as the structure remains in place, thus lowering the quantity and quality of the forage base in the estuarine habitat in the action area over several decades.

Effects of the increased stormwater discharge

Water Quality Degradation

The new stormwater outfall will result in an approximate 38% increase in the amount of stormwater discharge into the action area. This increased stormwater will comingle with stormwater that is currently collected within a catchment basin of downtown Tacoma. The catchment basin includes roads, parking lots, commercial buildings and warehouses. Stormwater discharge from this type of develop is well known to contain contaminants that can have adverse effects on salmon species (McIntyre et al. 2018; Spromberg et al. 2016; McIntyre et al. 2015). There are dozens of individual constituents within stormwater that may affect listed species in different many different ways. Additionally, these constituents can also interact with one another to have compounding effects at various ratios and concentrations.

The following brief summaries from toxicological profiles (ATSDR 1995; ATSDR 2004a; ATSDR 2004b; ATSDR 2005; ATSDR 2007) show how the environmental fate of each contaminant – some are similar to constituents detected in the City's stormwater. These and the subsequent exposure of listed species and critical habitats varies widely, depending on the transport and partitioning mechanisms affecting that contaminant, and the impossibility of linking a particular discharge to specific water body impairment (NRC 2009):

- DDT and its metabolites, dichlorodiphenyldichloroethylene (DDE) and dichlorodiphenyltrichloroethane (DDD) (all collectively referred to as DDx) may be transported from one medium to another by the processes of solubilization, adsorption, remobilization, bioaccumulation, and volatilization. In addition, DDx can be transported within a medium by currents, wind, and diffusion. These chemicals are only slightly soluble in water, therefore loss of these compounds in runoff is primarily due to transport of particulate matter to which these compounds are bound. For example, DDx have been found to fractionate and concentrate on the organic material that is transported with the clay fraction of the wash load in runoff. Sediment is the sink for DDx released into water where it is can remain available for ingestion by organisms, such as bottom feeders, for many years.
- The environmental fate of each type of PAH depends on its molecular weight. In surface water, PAHs can volatilize, photolyze, oxidize, biodegrade, bind to suspended particles or sediments, or accumulate in aquatic organisms, with bioconcentration factors often in the 10-10,000 range. In sediments, PAHs can biodegrade or accumulate in aquatic organisms or non-living organic matter. Some evaporate into the air from the surface but most do not easily dissolve in water, some evaporate into the air from surface waters, but most stick to solid particles and settle into sediments. Changes in pH and hardness may increase or decrease the toxicity of PAHs, and the variables of organic decay further complicate their environmental pathway (Santore et al. 2001).
- PCBs are globally transported and present in all media. Atmospheric transport is the most important mechanism for global dispersion of PCBs. PCBs are physically removed from the atmosphere by wet deposition (i.e., rain and snow scavenging of vapors and aerosols); by dry deposition of aerosols; and by vapor adsorption at the air-water, air-soil, and air-plant interfaces. The dominant source of PCBs to surface waters is atmospheric

deposition; however, redissolution of sediment-bound PCBs also accounts for water concentrations. PCBs in water are transported by diffusion and currents. PCBs are removed from the water column by sorption to suspended solids and sediments as well as from volatilization from water surfaces. Higher chlorinated congeners are more likely to sorb, while lower chlorinated congeners are more likely to volatilize. PCBs also leave the water column by concentrating in biota. PCBs accumulate more in higher trophic levels through the consumption of contaminated food.

- Due to analytical limitations, investigators rarely identify the form of a metal present in the environment. Nonetheless, much of the copper discharged into waterways is in particulate matter that settles out. In the water column and in sediments, copper adsorbs to organic matter, hydrous iron and manganese oxides, and clay. In the water column, a significant fraction of the copper is adsorbed within the first hour of introduction, and in most cases, equilibrium is obtained within 24 hours.
- For zinc, sorption onto hydrous iron and manganese oxides, clay minerals, and organic material is the dominant reaction, resulting in the enrichment of zinc in suspended and bed sediments. The efficiency of these materials in removing zinc from solution varies according to their concentrations, pH, redox potential, salinity, nature and concentrations of complexing ligands, cation exchange capacity, and the concentration of zinc. Precipitation of soluble zinc compounds appears to be significant only under reducing conditions in highly polluted water.
- A significant fraction of lead carried by river water occurs in an undissolved form, which can consist of colloidal particles or larger undissolved particles of lead carbonate, lead oxide, lead hydroxide, or other lead compounds incorporated in other components of surface particulate matters from runoff. Lead may occur either as sorbed ions or surface coatings on sediment mineral particles, or it may be carried as a part of suspended living or nonliving organic matter in water. The ratio of lead in suspended solids to lead in dissolved form has been found to vary from 4:1 in rural streams to 27:1 in urban streams. Sorption of lead to polar particulate matter in freshwater and estuarine environments is an important process for the removal of lead from these surface waters.

The City collected composite water quality samples from 14 storm events between Oct 17, 2016 and September 19, 2017 (Appendix C). The data in Appendix C shows specific constituent concentration levels for a many pollutant including nutrients, metals, and PAH’s. For this Opinion, we anticipate the increased stormwater discharges will likely contain similar amounts of contaminants and uses the data provided in Appendix C from which to base an analysis.
In 2012, NMFS issued a Biological Opinion that examined the effects of individual constituent concentration levels that now represent the State of Oregon’s water quality criteria (as adopted by EPA) (“Oregon Toxics Opinion” or NMFS 2008/00148). This analysis includes an evaluation of multiple chemicals allowed at acute and chronic levels, and allows for a comparative analysis with the City’s discharge data. After a review of the City’s discharge data, the best available science and the analysis of adverse effects contained in the Oregon Toxic’s Opinion, NMFS identified three specific constituents that occur in the City’s discharge at concentration levels that could result in adverse effects on listed species and their habitats. The constituents of concern are copper, lead and zinc. For each of these, levels present in the City’s stormwater exceeds the values evaluated in the Oregon Toxics opinion.

Chemical Mixtures.

In addition to specific constituents of concern named above, there are chemical mixtures in stormwater discharge. Where multiple toxic effluents are discharged to receiving water, the resultant ambient toxicity is of interest. Since each effluent is composed of individual toxic substances, a mixture of the effluents in receiving water produces a mixture of these individual pollutants. The overall ambient toxicity could be equal to the sum of each discharge's toxicity (additivity), less than the sum (antagonism), or greater than the sum (synergism). Once in the receiving water bodies, the discharged pollutants mix with pollutants from non-point sources and natural sources, at rates that are influenced by changes in rainfall. The result is an almost unlimited number of combinations of pollutant types and concentrations that varies nearly continuously and makes a quantitative mixture analysis extremely difficult. Nonetheless, the issue of chemical mixtures is an important line of evidence to consider when assessing the exposure-response effects and risks to the listed species and critical habitats considered in this Opinion.

The amount of contaminants in the effluent will vary over time. For example, higher pollutant concentrations during the beginning of single storm events, called first flush effects, have been consistently reported in highway runoff (Kayhanian et al. 2012). Thus, the concertation levels of copper, lead and zinc and the toxicity of the chemical mixture in the discharge will vary seasonally. Antecedent dry period, season, and first flush effects are important factors for most contaminants in stormwater runoff. In Puget Sound, most precipitation falls between October and March. Higher contaminant concentrations and loads in runoff were observed from March to September, indicating the influence of antecedent dry periods and therefore seasonality to build up pollutants (Ecology 2015). This seasonal trend was not observed for PAHs, phthalates, and pesticides. In Puget Sound, longer antecedent dry periods are correlated with higher concentrations of metals (Ecology 2014), ortho-P, dissolved organic matter, PAHs, and TSS (McIntyre et al. 2014). In Southern California, early season storms produced significantly higher metal flux than late season storms (Tiefenthaler, Stein, & Schiff 2008) and stormwater produced by the first storm of the year was more than three times as toxic as subsequent storms (Bay et al. 2003).

Higher pollutant concentrations during the beginning of single storm events, called first flush effects, have been consistently reported in highway runoff (Kayhanian et al. 2012). First flush effects have been observed for tire wear particles (Wik & Dave 2009), benzothiazoles (Reddy & Quinn 1997), metals (Tiefenthaler, Stein, & Schiff 2008), and aquatic toxicity (McQueen et al. 2010; Kayhanian et al. 2008). Stormwater is an important pathway for contaminants of emerging concern that were not studied in the Ecology & King County 2011 study. In a recent Central Sound monitoring study of contaminants of emerging concern, 17 detected contaminants in estuarine water were absent from wastewater effluent, suggesting other important pathways like stormwater runoff (Meador et al. 2016). In a California study of contaminants of emerging concern in mussel tissue, tissue concentrations in waters receiving stormwater input were significantly higher than those not receiving stormwater. Increasing concentrations of alkylphenol, PBDEs, and perfluorinated compounds were correlated with increasing urbanization and proximity to stormwater outfalls (Dodder et al. 2013).

Habitat Enhancement of Construction Easement and Shoreline.
Following removal of the coffer dam, the construction site along the Thea Foss waterway, the City provide habitat enhancements. This will include removing miscellaneous debris and concrete, and adding cobbles and LWD to the shoreline, will improve foraging and refuge habitat for juvenile salmonids and other species of fish. Improvements to the nearshore habitat for these species will be achieved by providing physical structures that will absorb excess wave energy and provide places along the shoreline adjacent to 1147 Dock Street where fish can forage and find refuge. A total of approximately 3,775 sf of nearshore habitat (below MHHW) is expected to be improved as part of the proposed habitat enhancements.

2.5.1 Effects on Critical Habitat

In this section we consider the intensity of expected effects in terms of the change they would cause in affected Primary Biological Features (PBFs) from their baseline conditions, and the severity of each effect, considered in terms of the time required to recover from the effect. Ephemeral effects are those that are likely to last for hours or days, short-term effects would likely last for weeks, and long-term and chronic effects are likely to last for months, years or decades. We then evaluate the end effect of these changes on the function or value of the PBF for its conservation role in the action area.

Puget Sound Chinook Salmon Critical Habitat
The essential PBFs of PS Chinook salmon critical habitat in the action area are nearshore marine are:

(1) water quality and quantity conditions and foraging opportunities, including aquatic invertebrates and fishes, supporting growth and maturation, and

(2) natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

(3) areas free of obstruction and excessive predation

PSGB Rockfish Critical Habitat
Rockfish critical habitat features are distinguished between species and between adults and juveniles, as each species and life history stage has different location and habitat needs. PBFs essential to the conservation of juvenile bocaccio rockfish include:

Juvenile settlement habitats located in the nearshore with substrates such as sand, rock and/or cobble compositions that also support kelp are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. Several attributes of these sites determine the quality of the area; these attributes include:

(1) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and

(2) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities.

PBFs essential to the conservation of adult bocaccio rockfish, and adult and juvenile yelloweye rockfish include benthic habitats or sites deeper than 98 ft that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rugose habitat. Several attributes of these sites determine the quality of the habitat including:

(1) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities,

(2) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities, and

(3) the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance.

SRKW Critical Habitat

For SRKW, marine waters within Puget Sound and the Strait of Juan de Fuca, typically greater than 20 ft in depth, are considered a PBF essential to SRKW conservation and recovery. These Marine waters must have:

(1) water quality to support growth and development;

(2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and

(3) passage conditions to allow for migration, resting, and foraging.

To account for each effect pathway on the function and value of designated critical habitat, factoring the preventative effects of proposed BMPs to minimize or offset effects, NMFS assigned the likelihood of PBF exposure, magnitude of PBF response and consequence of the PBF exposure and response, relative to each stressor, applying a rating of low, moderate or high. In other words, PBF's of critical habitat were assessed for a likelihood of exposure at low, moderate, or high; if exposure were to occur, the response was assessed as low, moderate, or high, and the combined consequence of likelihood and response were assessed as low, moderate, or high relative to conservation value of the PBF. These outcomes also add to the pathway of potential exposure and response among listed species addressed in the next section. Table 6 summarizes the exposure and response expected from the proposed action.

Table 6. Critical Habitat effects pathways from construction and operation of the municipal outfall in the Thea Foss waterway. NA denotes not applicable. Green =low, Yellow=moderate; Red =high.

		Critical Habitat		Habitat Analysis by PBFs		
Activity	Stressor	PBF	Species	Likelihood of exposure	Magnitude of response	Consequence of exposure and response to PBF
In-Water Construction	TSS	Water quality	PS Chinook	High	Medium	Medium
			Rockfish	High	Low	Low
			SRKW	High	Low	Low
Coffer dam placement	Reduction in Habitat	Prey and Forage Availability	PS Chinook	High	Low	Low
			Rockfish	Low	Low	Low
			SRKW	Low	Low	Low
New Out Fall Structure	Reduction in Habitat	Prey and Forage Availability	PS Chinook	High	Low	Low
		Migration and Passage	PS Chinook	High	Low	Low
Discharge/ Operations	Storm water	Water quality	PS Chinook	High	Medium	High
			Rockfish	High	Medium	High
			SRKW	High	Medium	Medium
		Prey and Forage Availability	PS Chinook	High	Low	Medium
			Rockfish	High	Medium	High
			SRKW	High	Medium	Medium

Effects on Features and Values of Critical Habitat

The critical habitat PBF's common to each species and life stage (as listed above) are water quality, abundant prey (quality and quantity of prey and forage availability), and areas with safe passage (migration and passage). We will present our analysis to features of habitat, and then consider the effect with regard to their conservation role in the action area.

Water Quality Degradation
Construction activities will temporarily increase TSS and reduce water quality and adversely affect the critical habitat for Puget Sound Chinook. Water quality reductions during construction are so brief, 150 days of in water construction, and are expected to occur in such a limited footprint, that the diminishment of this PBF for PS Chinook, is not likely to influence conservation values of any designated critical habitat in the action area.

The increased amount of stormwater discharge from the new outfall will chronically reduce water quality and adversely affect the critical habitat for PS Chinook, PS/GB yelloweye rockfish, PS/GB bocaccio, and SRKW. During future rain and runoff events that result in stormwater discharge from the new outfall, toxic concentration levels of copper, lead, zinc and chemical mixtures will occur at the point of discharge and enter the Thea Foss waterway. The adverse concentration levels are expected to dilute and not be detectable above background levels beyond the boundaries of Commencement Bay. The magnitude of this effect will vary seasonally, specifically, discharge events that occur with longer antecedent dry periods are likely to contain more toxic concentrations. This will incrementally reduce this PBF for PS Chinook, PS/GB yelloweye rockfish, PS/GB bocaccio, and SRKW, with the largest influence on the habitat value of PS Chinook salmon, due to the wide range lifestages in the actions area. Given that seasonal occurrence of stormwater (i.e., there will be periods of time that the stormwater is not present in the action area and the habitat will be available to ESA-listed species) and limited area impacts, the increased amount of stormwater is not likely to influence conservation values of any designated critical habitat in the action area

Reduction in Quality, Quantity and Availability of Prey and Forage
Cofferdam placement and increased TSS will temporarily reduce the quality and availability of prey and forage availability and thus adversely affect the critical habitat for PS Chinook. Construction related prey reduction will likely persist for a period of weeks or months after the removal of the coffer dam, as recolonization post disturbance depends on the presence of adjacent benthic communities to reseed the area. However, the footprint of this reduction is limited the area where construction will occur as well as a 150 foot mixing zone around the site (0.95 acres). This reduction will influence only one cohort of PS Chinook, and so we expect the construction activities will not substantially affect the conservation value of this PBF in the action area.

Habitat enhancements will be placed at the construction site, post construction. Approximately 3,775 sf of nearshore habitat (below MHHW) is expected to be improved as part of the proposed habitat enhancements. The proposed habitat improvements are expected to enhance the nearshore environment in the action and has the potential to benefit juvenile salmon use of this area.

The new outfall structure (the outfall and its discharge platform) will be permanently remove 140 square feet of critical habitat in the Thea Foss waterway, eliminate the prey communities that are and could support foraging juvenile and adult PS Chinook and thus adversely affect critical habitat for PS Chinook. The City's proposed habitat improvements (i.e., removal of concrete rubble and cobble placement) may reduce a portion of this impact. This small area of permeant removal relative to the available critical habitat with in the actions area would have an incremental negative impact but not substantially affect the conservation value of this PBF in the action area.

In addition to these physical diminishments to the prey base described above, prey communities will also be affected by exposure to the water quality contaminants in the effluent. The long term discharge of copper, lead, zinc and other heavy chemicals and biological contaminants will reduce water quality throughout the entire action area. The increased amount of stormwater discharge from the new outfall will chronically reduce the quality and availability of prey and forage availability and thus adversely affect the critical habitat for PS Chinook, PS/GB yelloweye rockfish, PS/GB bocaccio, and SRKW. Toxic concentrations levels of individual constituents as well as their mixtures that occurs during future rain and runoff will result in mortality, reduced growth, impairment of essential behaviors related to successful rearing and migration, cellular trauma, physiological trauma, and reproductive failure of prey resources for listed species. For PS Chinook and listed rockfish, discharge events would reduce quality and quantity of prey including benthic and planktonic organisms. Toxic concentration levels of copper, lead, zinc and chemical mixtures will occur at the point of discharge and enter the Thea Foss waterway. The adverse concentration levels are expected to dilute and not be detectable above background levels beyond the boundaries of Commencement Bay. The magnitude of this effect will vary seasonally, specifically, discharge events that occur with longer antecedent dry periods are likely to contain more toxic concentrations. This will incrementally reduce this PBF for PS Chinook, PS/GB yelloweye rockfish, PS/GB bocaccio, and SRKW. Given that seasonal occurrence of stormwater (i.e., there will be periods of time that the stormwater is not present in the action area and the habitat will be available to ESA-listed species) and limited area impacts, the increased amount of stormwater is not likely to influence conservation values of any designated critical habitat in the action area

For SRKW discharge events would reduce quality and quantity of prey including juvenile chinook. As PS Chinook salmon are a PBF of SRKW critical habitat, their repeated/chronic exposure to contaminants in successive cohorts, directly through diminished water quality, and via contaminated prey, both described above, results in a diminishment of the forage PBF of SRKW critical habitat. Both quantity and quality of prey will slightly decline, as these fish are likely to have latent health effects that slightly reduce adult abundance, and also reduce the quality of adult fish that do return and serve as prey, due to bioaccumulated contaminant. The Puyallup River Chinook, as part of the southern Puget Sound ESU scored a 5 out of 5 in NOAA's SRKW priority Chinook stock paper (NOAA 2018). This indicated that these fish are regularly eaten by SRKW at a time when their body condition is most vulnerable. This diminishment incremental and influences a small fraction of SRKW forage, therefore the effect on conservation value is not substantially affected.

Disruption of Migration/Passage

Fish that would normally swim closer to shore (12 ft above MLLW to 30 ft below MLLW) will swim into deeper waters to avoid the outfall and splash pad. Ono (2010) reports that juveniles salmonids tended to stay on the bright side of the shadow edge created by OWS, 2 to 5 meters away from the dock, even when the shadow line moved underneath the dock. These findings suggest that OWS can disrupt juvenile salmonid migration in the PS nearshore, degrading the role of this habitat for migration and foraging purposes.

The new outfall structure (the outfall and its discharge platform) will be incrementally will disrupt nearshore migration functions that support passage of juvenile chinook and thus will adversely affect PS Chinook critical habitat. The wing walls of the new splash pad will likely act as both physical walls through the shoreline and also generate some amount of shading on either side. Migration values are not expected to be impaired for PS/GB yelloweye rockfish, PS/GB bocaccio, as these species do not rely on the nearshore area for migration. This small amount of nearshore area (140 sq. foot) that the structure will occupy will have an incremental negative impact but not substantially affect the conservation value of this PBF in the action area.

2.5.2 Effects on Listed Species

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

As noted above in the effects to critical habitat, the project will have temporary, intermittent and permanent effects. Our exposure and response analysis identifies the multiple life stages of listed species that use the action area, and whether they would encounter these effects, as different life-stages of a species may not be exposed to all effects, and when exposed, can respond in different ways to the same habitat perturbations.

To account for each effect pathway on listed species, NMFS applied a stressor response magnitudes to applicable life stages, to qualitatively estimate a likelihood of individual exposure, magnitude of individual response and consequence of individual exposure and response to fitness. This also relied on a low, moderate, and high characterization for likelihood of individual exposure, magnitude of individual response, and combined consequence of exposure and response on population fitness. Finally, NMFS also estimated the probability of individual exposure, magnitude of individual response and consequence of individual exposure. These specific effect pathways included those that result from impacts to PBF and those that are more direct (i.e., fish handling, stormwater constituent interactions). NMFS combined all the stressors for each individual fish that are summarized in Table 7.

Table 7. Species effects pathways from construction and operation of the municipal outfall in the Thea Foss waterway. NA denotes not applicable. Green =low, Yellow=moderate; Red =high.

				Species Analysis by Life Stage										
Activity	Stressor	Species	Life Stage	Likelihood of exposure	Magnitude of response	Consequence to individuals	Life stage	Likelihood of exposure	Magnitude of response	Consequence to Individuals	Life stage	Likelihood of exposure	Magnitude of response	Consequences to Individuals
In-Water Construction	Reduced Water Quality	Salmon & steelhead	Eggs, embryo	NA			Juvenile, smolt, fry	Low	Low	Low	Adult	Low	Low	Low
		Rockfish	Eggs, larvae	Low	Low	Low	Juvenile	Low	Low	Low	Adult	Low	Low	Low
Coffer dam placement	Entrainment and Habitat Availiabity	Salmon & steelhead	Eggs, embryo	NA			Juvenile, smolt, fry	Medium	High	High	Adult	Low	High	High
		Rockfish	Eggs, larvae	Medium	High	High	Juvenile	Medium	High	High	Adult	Low	High	High
New Outfall Structure	Forage and Migration Disruption	Salmon & steelhead	Eggs, embryo	NA			Juvenile, smolt, fry	High	Medium	Medium	Adult	High	Low	Low
		Rockfish	Eggs, larvae	Low	Low	Low	Juvenile	Medium	Low	Low	Adults	Low	Low	Low
Discharge/ Operation	Reduced Water qualtiy and Forage Disruption	Salmon & steelhead	Eggs, embryo	NA			Juvenile, smolt, fry	High	High	High	Adult	High	High	High
		Rockfish	Eggs, larvae	Medium	High	High	Juvenile	Medium	High	High	Adult	Low	High	High
		SRKW	NA				Juvenile	Low	Low	Low	Adult	Low	Low	Low

Summary of effects on listed Species

As described in Section 1.3 (Proposed Action), all in-water work would occur only between July 15 and February 15 in any year the permit is valid. Stormwater discharged from the outfall will be going and concurrent with rain and run-off events, occurring when species are present.

Period of Exposure

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

Juvenile PS steelhead primarily emigrate from natal streams in April and May, and appear to move directly out into the ocean to rear, spending little time in the nearshore zone (Goetz et al. 2015). However, steelhead smolts have been found in low abundances in the marine nearshore, outside of their natal estuary, between May and August (Brennan et al. 2004), which overlaps with the in-water work window. Juvenile steelhead will therefore be present in Puget Sound during the early part of the work window, July 15 through August, however, because they enter the Sound after a longer freshwater residency, they are larger and less dependent on nearshore locations where work is going to occur. The proposed work window would minimize overlap of temporary construction effects with the presence in nearshore habitat of juvenile PS steelhead in the action area, but will not avoid all exposure.

Larval and Juvenile Rockfish. Larval rock fish presence peaks twice in the spawning period, once in spring and once in late summer. The in-water work window (July 15 to February 15) that is adhered to for salmon species makes it likely that during the fall spawning period a large numbers of larval rockfish, both PS/GB bocaccio and yelloweye.

Juvenile Summary. Because exposure cannot be fully excluded by in-water work timing for juvenile salmonids, juvenile bocaccio, or larval bocaccio and yelloweye, we evaluate other factors influencing potential presence of these fish, and if present, the potential duration of their exposure. Juvenile Chinook salmon are however, have the longest period in which they are nearshore oriented (Fresh 2006) and thus, although numbers are expected to be low at any given time, individuals of this species are likely more often per individual to encounter the intertidal and nearshore area where construction and enduring structure effects are anticipated.

Adult salmonids. The presence of adult PS Chinook salmon and PS steelhead in PS overlaps with the proposed in-water construction window. Like adult PS Chinook salmon, adult PS steelhead occupy deep water, generally deeper than the location where the structures are proposed. Thus, we expect the direct habitat effects from the structures to create little exposure or response among adult PS Chinook salmon and PS steelhead as they do not rely on the nearshore. However, some data suggests that up to of PS Chinook salmon spend their adult period in Puget Sound without migrating to the ocean (Arostegui et al.

2017), suggesting that most adult PS Chinook will experience far reaching effects such as water quality diminishments and reduced prey.

Adult Rockfish. The presence of adult PS/GB bocaccio and yelloweye in the action area is extremely low. Suitable habitat for is this lifestage is extremely limited based on preferred habitat depths and features such as rugosity. However, given the ability of this species to move throughout the marine environment, we cannot conclude that they would not ever occur within the action area over the lifetime of the outfall's operation.

Southern Resident Killer Whales. Between the three pods that comprise this DPS, identified as J, K, and L, some members of the DPS are present in Puget Sound at any time of the year though data on observations since 1976 generally shown that all three pods are in Puget Sound June through September, which means that all are likely present in the designated work window that begins on July 15. As discussed in the Status section, the whales' seasonal movements are only somewhat predictable because there can be large inter-annual variability in arrival time and days present in inland waters from spring through fall. Late arrivals and fewer days present in inland waters have been observed recent years. The likelihood of exposure to the construction or stormwater discharge is highly unlikely. However, they are likely to experience the consequences of reduced PS Chinook that will result from this proposed action (Olson et al. 2018).

Species Response to Habitat Changes

In this section we describe exposure and response of species to the adverse effects to habitat, and changes in critical habitat described in the previous section.

Water Quality Degradation
Water quality degradation includes turbid conditions during construction of the outfall, and increases in contaminant load from the operation of the outfall.

In-water construction -
Individual PS Chinook (juvenile and adult), and PS/GB bocaccio and yelloweye (larval, juvenile, and adult) within this area would exposed to elevation sediment levels during construction of the outfall. These individuals could listed species could experience disorientation, physiological stress (e.g., coughing), gill abrasion, and death. Individuals could also avoid the site and experience short-term disruption of feeding behavior.

In water work is expected to take up to 150 days. The amount of TSS should be very small, and with proposed BMP's will be constrained to the 200 linear ft immediately around the construction site. The increase in TSS will likely only be detectable within the small area (200 linear ft) as rising water levels from tidal actions are also known to naturally increase turbidity simultaneously.

We cannot estimate the number of individuals that will experience adverse effects from suspended sediment with any meaningful level of accuracy. We cannot predict the number or duration of each pulse of sediment, nor the number of individual fish that will be exposed during construction. Furthermore, not all exposed individuals will experience direct adverse effects. We expect that some individuals of listed fish species will experience sublethal effects such as stress and reduced prey consumption, some may respond with avoidance behaviors, and some may be injured. Those that engage in avoidance behaviors or with raised cortisol levels may have decreased predator detection and avoidance.

Based on the the work window that coincides with low presence of PS Chinook juveniles and adult, PS steelhead adults, and larval PSGB rockfish, the number of individuals from each species that would be exposed is expected to be very low. PS steelhead in the action area would be older/larger than PS Chinook juveniles, based on their long freshwater residency, and thus more able to avoid areas of high turbidity, such that any exposure would be brief, and their avoidance movement to deeper water would be less likely to expose them to greater risk of predators. Among PS Chinook, exposure could be somewhat more intense, and avoidance behavior into deeper water would put them at higher risk of predatory fishes as well as preclude them from valuable critical habitat. Larval and juvenile rockfish may be present in the area during increase turbidity as larval rockfish have a pelagic life stage and early juvenile rockfish settle out of the water column but with a low ability to move. Both of these life stages make it difficult for individuals to avoid affected areas.

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

Juvenile PS Chinook salmon are likely to be present during in-water construction activities and likely to be exposed to the temporary construction effects, most notably elevated levels of suspended sediment. The proposed minimization measures (i.e. only working in the dry) indicate that TSS levels will be only slightly elevated near the construction area and only during tidal inundations of the site during the project and during the first tidal inundation after completion of the project. Turbidity and TSS levels would return to background levels quickly and be localized to the in-water construction areas (150-foot radius turbidity mixing zone). While juvenile PS Chinook salmon are likely to encounter these areas, they can detect and avoid areas of high turbidity, and exposure is expected to be brief. Thus, duration and intensity of exposure of juvenile PS Chinook is also unlikely to cause injury or a harmful response.

While there is little information regarding the habitat requirements of rockfish larvae, other marine fish larvae biologically similar to rockfish larvae are vulnerable to low dissolved oxygen levels and elevated suspended sediment levels that can alter feeding rates and cause abrasion to gills (Boehlert 1984; Boehlert and Morgan 1985; Morgan and Levings 1989). Because the work window will overlap with one peak in larval presence, which is a several month pelagic stage without significant capacity for avoidance behavior (larval rockfish can swim at a rate of roughly 2 cm per second (Kashef et al. 2014) but are likely passively distributed with prevailing currents (Kendall and Picquelle 2003)), we can assume that 39 sites will have areas of high turbidity, and that larvae can be present in significant numbers (PS/GB bocaccio) that will be adversely affected.

Increased Stormwater Discharge - Because stormwater will discharge at any time of year, exposure of individual PS Chinook (juvenile and adult), and PS/GB bocaccio and yelloweye (larval, juvenile, and adult) within this action area will be exposed increased levels of stormwater discharged from the new outfall during rain and run-off events. All stormwater discharge is expected to contain concentration levels of copper that are toxic to fish and aquatic life. Many of the stormwater discharges will contain lead and zinc levels as well as chemical mixtures that are toxic to fish and aquatic species. The effects of exposure to toxic levels of continuants and chemical mixtures will effects that will range from mortality, reduced growth, impairment of essential behaviors related to successful rearing and migration, cellular trauma, physiological trauma, and reproductive failure.

The highest concentration levels are expected to occur at the point of discharge and that they will being to dilute as they enter the Thea Foss waterway. It is expected that by the time the stormwater is carried to the boundaries of Commencement Bay the effects of the dilution will be such that they individual copper, lead and zinc levels and the chemical mixtures in the discharge will be indistinguishable from background levels.

Concentration levels and toxicity of chemical mixtures will also be seasonally affected. First- flush rain events after long antecedent dry periods (periods of no rain) - that most typically occur in September are also expected to have extremely high levels of copper, lead and zinc. Higher concertation are also expected to occur between March and October in any given year – as there will be more dry periods during rain events. However, the occurrence of these events will occur with less frequency. Most discharge will occur between October and March, concurrent with when the region will received the most rain.

The Oregon Toxics Opinion evaluated the effects of ESA-listed fish, including salmonids, exposure to specific concentration levels of constituents, which are also found in stormwater, as well as the effects that occur when these constituents occur as mixtures. This allows for a comparative analysis with the City's discharge data. What follows is the comparative analysis between the City's data in Appendix C and the Oregon Toxics Opinion.

- Copper

Data in Appendix C shows that copper concentrations in the City's stormwater discharge ranged from 4.51 to 41.4 micrograms/liter (µg/L).

In the Oregon Toxics Opinion, NMFS evaluated 4.8 µg/L acute and 3.1 µg/L chronic copper levels. Section 2.6.3.4 of NMFS 2008/00148 discusses the effects of copper in the saltwater environment and is incorporated here by reference. In that Opinion, NMFS concluded that ESA-listed species, including salmonids, exposed to concentrations of copper equal to 4.8 µg/L for short durations (acute) and 3.1 µg/L for long periods of time (chronic) will suffer acute or chronic toxic effects including mortality and reproductive failure.

Based on the data in Appendix C, all of the 14 monitored storm events containing copper levels above 4.8 µg/L. If the data is representative of all discharges then it could construed that all future discharges will, at the point of discharge, contain copper levels that would be adverse to listed species and degrade critical habitat in the action area.

- Lead

Data in Appendix C shows that lead concentration levels in the City's stormwater discharge ranged from 4.321 to 64.9 µg/L.

In the Oregon Toxics Opinion, NMFS evaluated 210 µg/L acute and 8.1 µg/L chronic lead levels. Section 2.6.3.7 of NMFS 2008/00148 discusses the effects of lead in the saltwater environment and is incorporated here by reference. In that Opinion, NMFS concluded that ESA-listed species, including salmonids, exposed to concentrations of lead equal to 210 µg/L for short durations (acute) and 8.1 µg/L for long periods of time (chronic) will suffer acute or chronic toxic effects including mortality, physiological trauma, and reproductive failure.

Based on the data in Appendix C, 42 percent of the 14 monitored storm events had samples containing lead levels above 8.1 µg/L chronic level. As such it is expected that many future discharges will, at the point of discharge, contain lead levels adverse to listed species and degrade critical habitat in the action area.

- Zinc

Data in Appendix C shows that lead concentration levels in the City's stormwater discharge ranged from 37.2 to 200 micrograms/liter for zinc.

In the Oregon Toxics Opinion, NMFS evaluated 90 µg/L acute and 81 µg/L chronic zinc levels. Section 2.6.3.13 of NMFS 2008/00148 discusses the effects of zinc in the saltwater environment and is incorporated here by reference. In that Opinion, NMFS concluded that ESA-listed species, including salmonids, exposed to concentrations of lead equal to 90 µg/L for short durations (acute) and 81 µg/L for long periods of time (chronic) will suffer acute or chronic toxic effects including mortality and reproductive failure.

Based on the data in Appendix C, 36 percent of the 14 monitored storm events had samples containing zinc levels above 81 µg/L. As such it is expected that many future discharges will at the point of discharge contain lead levels adverse to listed species and degrade critical habitat in the action area.

In addition to the exposure to the unique contaminants above, fish will be exposed to a chemical mixture in stormwater. Section 2.6.4 of the Oregon Toxics Opinion analyzed the effects of chemical mixtures of constituents that occur in stormwater and are incorporated here by reference. The Oregon Toxics Opinion concluded that for chronic saltwater criteria for metal compounds, fish exposed to multiple compounds, versus a single compound exposure, are likely to suffer toxicity greater than the assessment effects (*e.g.*, 50 percent mortality) such as mortality, reduced growth, impairment of essential behaviors related to successful rearing and migration, cellular trauma, physiological trauma, and reproductive failure.

In an examination of effect on juvenile salmon, McIntyre et al (2015) exposed sub yearling Coho salmon to urban stormwater. 100% of the juveniles exposed to untreated highway runoff died within 12 hours of exposure. McIntyre et al (2018) later examined the prespawn mortality rate of coho salmon exposed to urban stormwater runoff. In their experiments 100% of coho salmon exposed to stormwater mixtures expressed abnormal behavior (lethargy, surface respiration, loss of equilibrium, and immobility within 2 to 6 hours after exposure.

We cannot estimate the number of individuals that will experience adverse effects from exposure to stormwater any meaningful level of accuracy. We cannot predict the number or duration of each pulse of discharge events, nor the number of individual fish that will be exposed during those events. Furthermore, not all exposed individuals will experience immediate adverse effects. We expect that every year some individuals PS Chinook (juvenile and adult), and PS/GB bocaccio and yelloweye (larval, juvenile, and adult) will experience sublethal effects such as stress and reduced prey consumption, some may respond with avoidance behaviors that disrupt feeding and migratory behavior, and some experience reduced growth, impairment of essential behaviors related to successful rearing and migration, cellular trauma, physiological trauma, reproductive failure, and mortality.

Reduction in Quality, Quantity and Availability of Prey and Forage and Migration

Construction Activities

Individual PS Chinook (juvenile and adult), and PS/GB bocaccio and yelloweye (larval, juvenile, and adult) will experience a temporary reduction in quality and quantity of available prey and forage and could experience to their feeding behavior. The coffer dam and increased sediment levels in the action area could temporarily restrict individual species from accessing habitat to forage. Individual that do access the site will experience a temporary reduction the quality and quantity of forage or prey available. Individuals PS Chinook (juvenile and adult), and PS/GB bocaccio and yelloweye (larval, juvenile, and adult) may respond with avoidance behaviors that disrupt feeding and migratory behavior. Increased energy expended to forage can reduce individual fitness, making individual more susceptible to predation or disease.

We cannot estimate the number of individuals that will experience adverse effects from this temporary reduction in quality and quantity of prey and foraging habitat. This disruption is expected to occur for up to 150 days. The area of disruption is very small, available forage habitat in the action area, and with proposed BMP's will be constrained to the 200 linear ft immediately around the construction site. Not all exposed individuals will experience direct adverse effects.

Response to the New Outfall Structure

Based on its location, only salmonid species will be exposed to the outfall and its associated structure, though because some effects of the structure are biotic, they will likely have also affect rockfish and SRKW later in time and further away.

Placement of the outfall and splash pad will completely remove any forage base originating or dependent on 140 square foot area of benthic habitat located under the outfall and splash pad. These structures will likely reduce the abundance of prey organisms for juvenile salmonids and also affect habitat complexity by reducing aquatic vegetation and phytoplankton abundance. There is likely to be a long-term reduction in prey base resulting from the existence of the outfall. Forage fish such as Pacific herring, Pacific sand lance, and surf smelt are present throughout the action area, but spawning locations are few. WDFW has identified surfsmelt spawning beaches within 0.8 miles from the construction site. Several other spawning sites have been documented by WDFW in Commencement Bay.

Vegetation and substrate along the Thea Foss waterfront provide substrate for invertebrates, such as copepods, amphipods, and snails, which might otherwise not be found on soft sediments (Mumford 2007). Copepods and other zooplankton represent the major food base for the food chain in Puget Sound, specifically for small and juvenile fish including Pacific herring, sand lance, surf smelt, and salmonids. The intertidal provide important habitat for a variety of marine invertebrates and fishes, including salmonid species.

All salmon exposed to these diminished prey conditions are likely to experience a reduction in their individual growth, fitness, survival, and the populations will experience constraint on their total abundance. In general, early marine juvenile growth is dependent on ample food supply and has been shown to be linked to overall salmonid survival and production (Beamish et al., 2004) (Tomaro et al., 2012). Rapid growth of PS Chinook salmon during the early marine period is critical for improved marine survival (Duffy and Beauchamp, 2011).

We cannot estimate the number of individual fish that will experience adverse effects from this 140 square foot reduction in quality and quantity of prey and foraging habitat. These anticipated effects will persist as long as the structure remains in place, lowering the quantity and quality of the forage in the action area over several decades. While both juvenile PS steelhead and Chinook salmon use the action area, the larger size/age of steelhead make them less dependent on nearshore prey. Juvenile Chinook salmon are likely to have greater competition for site specific prey, and to forage farther for equivalent nutrition. Taken together, these effects will have an incremental reduction in growth and fitness among each cohort of PS Chinook salmon and PSGB rockfish in the action area for the foreseeable future.

Additionally, the presence of the structure creates an obstruction in the migratory area that juvenile salmonids will avoid/swim around. The physical pushing them into deeper water will cause an increase in energy expenditure and timing of movement. This could decrease growth as more energy is directed to holding and swimming, increase susceptibility to predation, and decrease fitness as individual juveniles, particularly PS Chinook salmon, enter the marine environment.

<u>Response to Increased Stormwater Discharge</u>

Fish Response - As described earlier in this section, the toxicity of the increased stormwater discharged from new outfall in some cases would result injury that could lead to delayed or instant mortality to aquatic life. These effects are another expected to reduce prey base available to individual PS Chinook (juvenile and adult), and PS/GB bocaccio and yelloweye (larval, juvenile, and adult). Further, mortality of PS Chinook that succumb exposure to toxic stormwater, consequently impact the availability of PS Chinook as SRKW prey. In response individual listed fish would increase energy expenditure to additive forage activities that can reduce individual fitness, making individual more susceptible to predation or disease.

Reduced prey availability will be ongoing and will occur concurrent with rain and runoff events that discharge through the new outfall; thus, these effects will episodic in nature but throughout a given year. The extent of ESA-listed fish and SRKW prey reduction will be dependent on the concentration of toxic and the duration of time the prey reduction occurs. The prey reductions would coincide with prey exposure to concentration levels and toxicity of chemical mixtures. As such with the timing listed above for those effect, we would expect prey reductions to occur most often between October and March, concurrent with when the region will received the most rain. Prey reducing effects between March and October would be less frequent concurrent with the spring and summer seasons and fewer expected rain events. Some prey resourced could recover in-between discharge events. While not all prey in the action area will die, most will be exposed to the stormwater contaminants. Exposure to contaminated forage is likely to adversely affect PS Chinook salmon and PS steelhead. Contaminants such as PAHs and PCBs would be biologically available at the site into the foreseeable future due to the continuous input from the creosote-treated piles and other sources of pollution discussed above.

Amphipods and copepods uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum *et al*. 1984; Neff 1982), and pass them to juvenile Chinook salmon and other fish through the food web. Varanasi *et al*. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in a contaminated waterway (Duwamish). They also reported reduced growth, suppressed immune competence, as well as increased mortality in juvenile Chinook salmon that was likely caused by the dietary exposure to PAHs. Meador *et al*. (2006) demonstrated that dietary exposure to PAHs caused "toxicant-induced starvation" with reduced growth and reduced lipid stores in juvenile Chinook salmon. The authors surmised that these impacts could severely impact the odds of survival in affected juvenile Chinook salmon. Juvenile PS steelhead were not specifically addressed in the available literature, but it is reasonable to expect that they may be similarly affected by dietary uptake of contaminants.

We cannot estimate the number of individuals ESA-listed fish that will experience adverse effects from a reduction in quality, quantity and availability of prey and forage with any meaningful level of accuracy. We cannot predict the number or duration of reduced prey events, nor the number of individual fish that will be exposed during those events. Furthermore, not all exposed individuals will experience direct adverse effects. We expect that every year some individuals PS Chinook (juvenile and adult), and PS/GB bocaccio and yelloweye (larval, juvenile, and adult) will experience sublethal effects such as stress and reduced prey consumption, some may respond with avoidance behaviors that disrupt feeding and migratory behavior, and some experience reduced growth, impairment of essential behaviors related to successful rearing and migration, and mortality.

SRKW Response – PS Chinook salmon are the primary prey item for SRKW. PS Chinook salmon may slightly decline in abundance, or decline in fitness, as a result of exposure to the effluent from the proposed outfall. When prey is scarce, SRKW likely spend more time foraging than when prey is plentiful. Increased energy expenditure and prey limitation can cause poor body condition and nutritional stress. The individual stress and diminished body condition of individuals would lead to an overall decline in the fitness of the species.

NMFS qualitatively evaluated long-term effects on the SRKW from the anticipated reduction in PS Chinook salmon. We assessed the likelihood for localized depletions of PS Chinook, and in turn the long-term implications for SRKW' survival and recovery, resulting from the proposed action presenting risks to the continued existence of PS Chinook salmon and reducing the ability for the ESU to expand and increase in abundance. Viability at the population level is a foundational necessity for PS Chinook salmon persistence and recovery, and in this way, NMFS can determine whether the reduced likelihood for survival and recovery of prey species is also likely to appreciably reduce the likelihood of survival and recovery of SRKW.

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

Differences in adult salmon life histories and locations of their natal streams likely affect the distribution of salmon across the Southern Residents' geographic range. The continued decline and reduced potential for recovery of the PS Chinook salmon, and consequent interruption in the geographic continuity of salmon-bearing watersheds in the Southern Residents' critical habitat, is likely to alter the distribution of migrating salmon and increase the likelihood of localized depletions in prey, with adverse effects on the Southern Residents' ability to meet their energy needs. A fundamental change in the prey base within critical habitat is likely to result in Southern Residents abandoning areas in search of more abundant prey or expending substantial effort to find depleted prey resources. This potential increase in energy demands should have the same effect on an animal's energy budget as reductions in available energy, such as one would expect from reductions in prey.

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

The Puyallup River Chinook, as part of the southern Puget Sound ESU are considered one of twelve SRKW priority prey stocks (NOAA 2018). As we are not able to determine the number Puyallup River Chinook that would be reduced as part of this action we are also not able to quantify the effects to an individual SRKW. Further, there currently is not a direct linear relationship with reduced prey base and SRKW survival, as there are other factors that cumulatively are impacting survival (as described in Section 2.3.1 above). At best we conclude that the loss of Puyallup River Chinook that would have otherwise provided forage opportunities for SRKW, could result increase the amount of forage effort for individual SRKW. For individual SRKW that may be experiencing poor fitness conditions (e.g., starvation or disease), increased forage effort could amplify or exacerbate poor fitness.

Direct Effects on Species

Fish Entrapment and Handling

As described in section 1.3 the construction activities for the new outfall includes the construction of a coffer dam. Coffer dams are designed to keep construction areas dry and the substrate accessible, and to exclude fish from the area where work will occur. The process of creating a dry environment includes the physical extraction of fish from within the dam. While considered a BMP and minimization measure, this practice is not without adverse effects itself.

Entrainment of migrating and rearing juvenile fish can occur when fish are trapped during the uptake of sediments and water by excavation machinery, which can cause injury or death. The probability of entrainment is largely dependent upon the likelihood of fish occurring within the work area, fish densities, work depth, location of work within the river, equipment operations, time of year, and the species' life stage. Low densities of ESA-listed salmonids are likely to be present in the action area during excavation and backfilling of the trench.

Pumping out water from within the coffer dam will result in the capture and physical abrasion of any fish that remain inside of the dammed area. The suction created by the water intake may draw in these younger individuals and pass them through the pump system and out of the coffer dam. During their transport through the water pump it is likely that any larval or juvenile fish will be exposed to numerous physical and chemical hazards. These hazards include abrasion against pipe walls, entrainment against screens, concussive blows from passing through mechanical pumps. Survival within the pump and outflow pipe are extremely unlikely. Mortality for all fish (salmonids and rockfish) that enter the intake is expected to be 100 percent.

Even though the goal of the fish exclusion is to reduce mortality of fishes from work within habitat areas, capturing and handling fish to exclude them from the work area can cause short-term stress, disrupt normal behavior, and may result in injury or mortality (Frisch and Anderson 2000). Fish handling may increase predation exposure and predator avoidance (Olla et al. 1992). Injury and handling stress from nets and seines are expected to be lower than the stress from standard electroshocking but may still result in adverse effects.

Work site isolation, fish exclusion, and fish handling pose inherent risks to fish, especially if the activity involves electroshocking to capture and relocate any fish present within the in-water isolation area. Because all listed fish species may be present during proposed construction, it is possible that some juvenile Chinook salmon or steelhead maybe be injured or killed during the initial portion of in-water work, as the isolation structures are placed within active flows. The applicant would minimize risks by ensuring that only qualified biologist(s), who is also experienced with work area isolation, oversee the fish exclusion activities and follow guidance outlined in the NMFS' Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols (NMFS 2000) and USFWS Recommended Fish Exclusion, Capture, Handling, and Electroshocking Protocols and Standards (Snyder 2003; USFWS 2012).

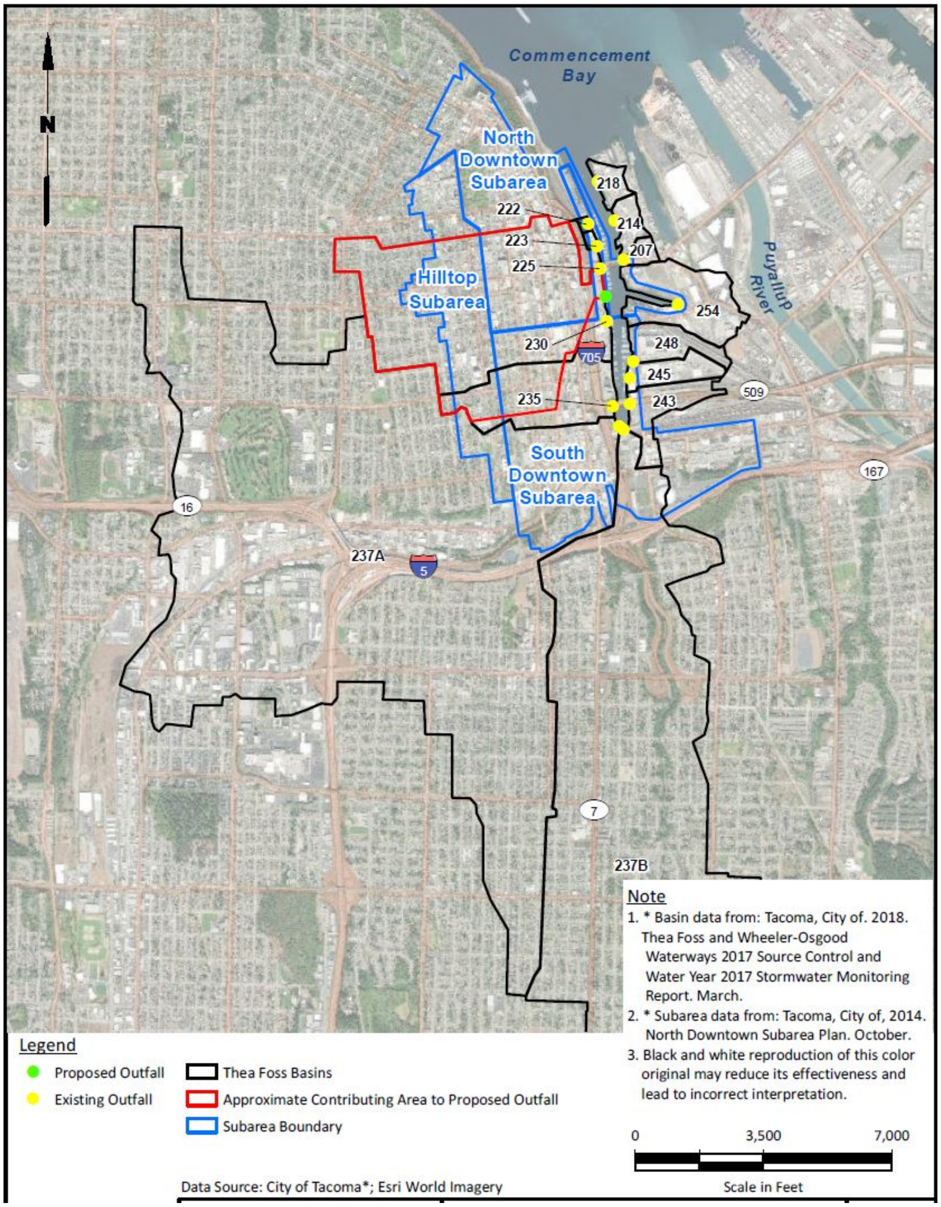

Figure 3. Drainage basin for proposed new outfall.

2.6 Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the Environmental Baseline section (Section 2.4).

The current condition of ESA-listed species and designated critical habitat within the action area are described in the Status of the Species and Critical Habitat and the Environmental Baseline sections above. The contribution of non-federal activities to those conditions include past and on-going bankside development in the action area, as well as upstream forest management, agriculture, urbanization, road construction, water development, and restoration activities. Those actions were driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of conservation groups dedicated to restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, NMFS is reasonably certain that future non-federal actions such as the previously mentioned shoreline and upstream activities are all likely to continue and increase in the future as the human population continues to grow across the region. Continued habitat loss and degradation of water quality from development and chronic low-level inputs of non-point source pollutants will likely continue into the future. Recreational and commercial use of the waters within the action area are also likely to increase as the human population grows.

The intensity of these influences depends on many social and economic factors, and therefore is difficult to predict. Further, the adoption of more environmentally acceptable practices and standards may gradually reduce some negative environmental impacts over time. Interest in restoration activities has increased as environmental awareness rises among the public. State, tribal, and local governments have developed plans and initiatives to benefit ESA-listed PS Chinook salmon and PS steelhead within many of the watersheds that flow into the action area. However, the implementation of plans, initiatives, and specific restoration projects are often subject to political, legislative, and fiscal challenges that increase the uncertainty of their success.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (section 2.2), to formulate the agency's Opinion as to whether the proposed action is likely to: (1) appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat for the conservation of the species.

Of the listed species considered in this Opinion, three are threatened with extinction (PS Chinook, PS steelhead, and PS/GB yelloweye rockfish) and two are endangered by the threat of extinction (PS bocaccio and SRKW). Each species' listing status is due in part to low abundance, and low productivity. PS steelhead and PS Chinook salmon each have reduced diversity and spatial structure. Factors that limit productivity for the salmonids, SKRW, and bocaccio rockfish include habitat degradation in many areas within their geographic range or their designated critical habitat. Many of the baseline conditions are considered limiting. Poor water quality affects each of the species, poor prey base (both quality and quantity) are concerns for SRKW, with ongoing risks from vessels via either noise, or ship strikes.

As described in more detail above at Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the Opinion. It is also likely to increasingly affect the PBF of designated critical habitats. The exact effects of climate change are both uncertain, and unlikely to be spatially homogeneous. However, climate change is reasonably likely to cause reduced instream flows in some systems, and may impact water quality through elevated in-stream water temperatures and reduced DO, as well as by causing more frequent and more intense flooding events.

Climate change may also impact coastal waters through elevated surface water temperature, increased and variable acidity, increasing storm frequency and magnitude, and rising sea levels. The adaptive ability of listed-species is uncertain, but is likely reduced due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. The proposed action will cause effects on the ESA-listed species and critical habitats considered in the Opinion well into the foreseeable future. However, the action's effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on ESA-listed species or critical habitat through synergistic interactions with the impacts of global climate change are expected.

Cumulative effects of non-federal activities, and are generally derivative human population growth and development in the upland environment. Over the foreseeable future, the human population is expected to continue growing, intensifying land and water use, will continue to add incremental degrading effects on water quality in the action area.

2.7.1 Effects to Species at the Population Scale

In light of the status of species, critical habitat, baseline, and cumulative effects reiterated above, we add the effects of the proposed action. As identified in Section 2.2, the proposed action is likely adversely affect individuals from 5 ESA-listed species considered in the Opinion. Of the many populations comprising the two salmonid species that have had a viability analysis completed, few rate as "viable."

We considered the effects of the proposed action in the context of those extinction risks. The proposed stormwater outfall is likely to expose individual fish from the Puyallup, White and Carbon populations of the salmonid species considered in this Opinion to slightly decreased water quality by stormwater run-off. Individual fish will respond to that exposure in different ways depending on their life history stage at exposure. That, in turn, will determine (1) the duration of the exposure (e.g., rearing fish are exposed longer than migrating fish), (2) the pathways of exposure (e.g., prey or water quality), and (3) the nature of effect (e.g. juveniles more likely to experience latent sub-lethal effects, returning adults are more likely to experience impaired olfactory function that can impair homing ability). Relevant environmental cycles influencing exposure include the probabilistic time necessary for existing pollutants to flush from the basin by river discharge as measured in a half-life estimated to last for days for dissolved pollutants, but will require decades for pollutants adsorbed or absorbed onto sediment.

Of the species exposed to these water quality changes, those that are likely to have the greatest level of exposure and response are likely to be steelhead, whose vulnerable juvenile life stage is known to pass through the action area at the mouth of the Puyallup River, and spring Chinook, which can rear for a year before their migration to salt water. The exposure to additional load among these populations will be adverse but that we will not be able to distinguish the additional health effects at the population scale because mortality and reduced fitness are hard to detect separate from an outright fish kill. There are no separate spawning populations for PSGB bocaccio or Yelloweye rockfish and as such both populations are equally likely to be exposed, at all life stages, though exposure at the larval lifestage is likely to have the most consequences at the individual scale. Larval presence is highly variable and dependent upon adults being present near the action area to spawn. Because habitat conditions favorable to adult rockfish are not present in the action area, we anticipate that only a very small fraction of rockfish larvae will be exposed in any given year, and even when factored over time, the affected number is insufficient to modify abundance or productivity of either species.

SRKW is also likely to be exposed indirectly through the juvenile and adult consumption of prey (salmon) that have been exposed to the contaminants. This exposure is likely to occur among all members of the three pods that comprise the ESU, based on their extended presence in Puget Sound. But, similar to fish species, the chronic nature of this exposure among SRKW, while likely to be adverse, is not expected to so differ in the intensity or duration from the baseline level of exposure that it would alter the abundance of the species. Effects among individuals will be difficult to discern or distinguish from existing conditions.

The responses are likely to include multiple episodes of impairment of essential fish rearing and feeding behavior patterns for some individuals among each cohort of each of the listed fish species considered. Early life history development of both salmonid species and rockfish may also be affected by these contaminants. Direct exposure of individual fish to acute levels of the three constituents listed in section 2.6.3.2 may result in instantaneous tissue damage and mortality. As SRW absorb more heavy metals and other contaminants from the stormwater they may experience neurological disorders, reduced reproductive success and lower feeding rates.

In summary, given the rangewide status of the species likely to be adversely affected by the proposed action, the environmental baseline in the extensive action area, the effects of the proposed action on species, and cumulative effects in the action area. The proposed action poses a chronic, and additive risk to listed species considered in this Opinion, but at a scale and intensity which cannot be distinguished from existing conditions or population trends.

2.7.2 Effects on Critical Habitat Conservation Value

Similar to the additive analysis presented in Section 2.7.1 above, we also consider the effects to critical habitat from the proposed action in the context of the status of critical habitat and baseline conditions. As noted in Sections 2.2 and 2.3, climate change and human development have affected, and continue to adversely affect, critical habitat creating limiting factors and threats to the recovery of the ESA listed species. The action area is designated as critical habitat for ESA-listed salmon, rockfish, and southern resident killer whales. PBFs designated for the listed fish species include those physical and biological features that support the following site types:

- Puget Sound Chinook salmon –estuarine areas and marine nearshore areas
- Puget Sound Georgia Basin rockfish – marine nearshore and marine deep shore zones
- Southern Resident Killer Whales - coastal marine area

Features of critical habitat for listed fish, as a baseline condition throughout the action area, are degraded by multiple anthropogenic changes, included modified hydrographs, reduced complexity of stream habitat, and diminished water quality. Federal, tribal, state and local entities are actively carrying out habitat improvement projects, but at the same time, human population growth and development pressures on aquatic systems are increasing throughout many areas in Washington State. The long-term consequences of human population growth trends may further reduce habitat values necessary to support fish populations and degrade the quality and function of critical habitat. Climate change will have a range of effects on habitat contemporaneous with the 10 year term of this program which could exert additional downward pressure on habitat functions.

For marine mammals, prey and water quality are features of critical habitat for these species and each is currently diminished at a baseline condition. For SRKW in particular, contaminated prey and lack of prey are points of significant concern. As described above, in the analytical sections of this document, both water quality and prey are likely to be incrementally but chronically affected by the proposed action, but at a scale and intensity that is difficult to distinguish from baseline levels.

In this context, the for critical habitats of all listed species considered in this document, the effects of the proposed action are likely to cause a very small additional detriment to the PBFs related estuarine, and marine conditions, via substrate and water quality, and prey communities, when contaminated runoff from the stormwater outfall reach waterways. The discharges will occur episodically, and with each episode briefly reduce water quality and forage components of critical habitats during and after each discharge throughout the design life of the project. However, the duration and severity of each effect will vary widely based on specific contaminants present within the drainage basin, precipitation event characteristics, such as the discharge flow in the receiving water, the amount of impervious area in the project, the length of antecedent dry period, and the type and amount of precipitation.

The increment of water quality degradation that this specific municipal stormwater project will add to the baseline condition is small but chronic. At the scale of the full proposed action these effects are additive to the already severely degraded water quality around the city of Tacoma and Port of Tacoma. For this reason, the number of individual fish that ultimately will be injured or killed by this projects is likely to be concentrated in a way that has a more intense effect on one salmonid population (Puyallup) compared to another. Post-construction stormwater runoff from this individual municipal stormwater outfall is expected to be less contaminated than previous outfalls due to the city of Tacoma's promise to improve water quality treatment for the catchment basin. When compared to the existing water quality levels within the action area, which include a major city and port, this outfall's contribution is expected to have a lower level of impairment and will not preclude the long term enhancements of water quality of the action area should the Port of Tacoma and other municipal storm systems be fixed. Post-construction habitat enhancements of the construction site, expected to further minimize the degradation. The contemporaneous effects of climate change are likely to have a similar chronic and slightly negative effect on populations that cannot be estimated with any precision and which are also, generally, very difficult to distinguish from baseline conditions.

The conservation value of the critical habitat in the action area is unlikely to be meaningfully reduced by the proposed action.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon, PS steelhead, PSGB rockfish, or SRKW, nor is it likely to destroy or adversely modify designated critical habitat for PS Chinook salmon, PSGB rockfish, or SRKW.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement (ITS).

Accordingly, this ITS provides a take exemption for the USACE and applicant for any take caused by the direct effects of the proposed action e structure. Those direct effects are injury or death caused by fish exclusion and handling, temporary and permanent loss of forage, the 38% increase in stormwater discharge, and harm associated with a temporary increase in suspended sediments during in-water work.

<u>2.9.1 Amount or Extent of Take</u>

NMFS determined that incidental take is reasonably certain to occur in the form of harm in the following manner, and is the responsibility of each party identified:

Harm of PS Chinook salmon (juvenile, adults) and PS steelhead (juvenile, adults) from exposure to:

- Construction related temporary increases in TSS and temporary reduction in prey during installation of the new outfall (USACE)
- Entrapment and Fish Handling (USACE); this harm will result in injury or death
- Increased stormwater discharges (City of Tacoma)
- Permanent reduction of forage base associated with water quality reductions (City of Tacoma)

Harm of PSGB rockfish (larval, juvenile, and adult) from exposure to:

- Construction related temporary increases in TSS and temporary reduction in prey during installation of the new outfall (USACE)

- Entrapment and Fish Handling (USACE); this harm will result in injury or death
- Increased stormwater discharges (City of Tacoma)
- Permanent reduction of forage base associated with water quality reductions (City of Tacoma)

Harm of SRKW from exposure to:

- Permanent reduction of forage base associated with water quality reductions (City of Tacoma)

NMFS cannot predict the number of PS Chinook salmon, PS steelhead, or PSGB yelloweye and bocaccio rockfish that are reasonably certain to be injured or killed by exposure to any of these stressors. The distribution and abundance of the fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics that vary over time. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action.

Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts, either from habitat-related harm, or from entrainment. In such circumstances, NMFS uses the likely extent and duration of changes in habitat conditions that are causally linked to harm, to describe the extent of take as a measurable and verifiable metric.

For this proposed action, the most appropriate surrogates for take are action-related parameters directly influence the area in which harm will occur, or the duration of the harming activities.

Accordingly, the extent of take in the form harm

- from temporary reduced prey base associated with construction impacts extending for 150 ft radially from construction site for 150 days during 2 work windows.
- from entrainment is 300 square ft that will be coffer dammed for 150 days over two work windows.
- from permanent reduced prey base associated with presence of new outfall structure is 140 square ft.
- from chronic diminished prey quality from contaminant concentration levels no higher than 41.4 micrograms/liter for copper, 64.9 micrograms/liter of lead, and 200 micrograms/liter for zinc at the point of discharge

Exceedance of any of the exposure limits described above would constitute an exceedance of authorized take that would trigger the need to reinitiate consultation.

Although these take surrogates could be construed as partially coextensive with the proposed action, they nevertheless function as effective re-initiation triggers. If the size and configuration of the structure exceeds the proposal, it could still meaningfully trigger re-initiation because the Corps has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4). The city of Tacoma has proposed continued water quality monitoring, so if the water quality should decrease beyond the limits addressed in the Opinion it would trigger re-initiation.

2.9.2 Effect of the Take

In the Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to jeopardize the continued existence of PS Chinook salmon and PS steelhead, nor is it likely to destroy or adversely modify designated critical habitat for PS Chinook salmon (Section 2.8).

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" (RPMs) are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02).

The COE shall require the applicant to:

1. Implement monitoring and reporting to confirm that the Take exemption for the proposed action is not exceeded.
2. Reduce take through application of effective construction Best Management Practices.
3. Reduce take through application of effective stormwater management.
4. Minimize the take associated with the loss of habitat functions resulting from placement of new outfall structure.

2.9.4 Terms and Conditions

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

1. To implement RPM number 1, the applicant shall implement a monitoring and reporting program to confirm that the take exemption for the proposed action is not exceeded, the applicant shall collect and report details about the discharge of polluted stormwater coming from the outfall. That plan shall:
    a. Include monitoring of all constituents listed in appendix C for 5 years after the new outfall reaches full operational capacity.
        i. As consistent with the applicant's NPDES, sample water at the end of the outfall pipe annually, during at least 7 storm events.
    b. Include monitoring of copper, lead, and Zinc during at least 7 storm events each year, between October 1st and September 30th, for at least 5 years to ensure the maximum levels of contaminants assumed to be discharged in this Opinion's analysis are not exceeded.
    c. Utilize sampling and testing methodologies approved by WA department of Ecology.

2. To implement RPM number 1, the USACE shall provide a post construction report including;
   a. Final dimensions of outfall structure.
   b. Final tidal elevations of outfall structure.
   c. Date and time of completion of construction.

3. To implement RPM number 2, the USACE shall require the applicant to implement the following construction BMPs'
   a. When constructing the coffer dam, construct the first three sides and leave the fourth open and use the opening to herd any remaining fish in the dam out before constructing the fourth side.

4. To implement RPM number 2, the applicant shall minimize and document Take of listed species during construction by;
   a. Use sein nets during coffer dam construction rather than pumps.
      i. Use nets to corral, collect and remove fish from coffer dam.
   b. Monitoring of construction site during coffer dam assembly and disassembly;
      i. Identify and enumerate salmonid and rockfish found within the dam.
      ii. Provide a copy of the monitoring report to NMFS post construction.

5. To implement RPM number 3, the applicant shall implement the actions listed in Appendix B, per the mutual understanding and agreement reached during the March 5 2020 meeting.
   a. The applicant shall provide an annual report to NMFS documenting the completion of each action listed in Appendix B.

6. The following terms and conditions implement reasonable and prudent measure 4. To minimize incidental take resulting from the new outfall, the applicant shall:

   a. Improve the same type of habitat within the action area that is affected by the proposed action and that will be used by the same listed species, by doing one of the following within 3 years of outfall construction:
      i. Remove manmade structures on City of Tacoma owned marine areas or marine shorelines that would have a habitat improvement of at least 0.21 Discounted Service Acres (DSAYs), which represents the quantified habitat impact from area covered by the new outfall.
      ii. Partner with the local watershed council or other local organizations to contribute funds to a project that is improving habitat within the Commencement Bay area for at least 0.21 DSAYs.
      iii. Purchase credits equivalent to at least 0.21 DSAYs from a NMFS-approved conservation bank or in-lieu fee programs, or a NMFS-approved third-party responsible agreement.
   b. The proposed removal of manmade structures must be assessed and approved by NMFS to determine the adequacy of habitat replacement.
   c. Bank armoring being modified as part of the proposed action does not count toward minimizing incidental take from the new stormwater outfall.

d. Submit an electronic post-construction report to NMFS within 12 months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include Attn: WCRO-2019-00727 in the subject line.

2.10 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. The applicant should implement water treatment protocols and build infrastructure to reduce contaminant levels below detectable levels.
2. The applicant should implement water treatment protocols and build infrastructure to reduce contaminants in the discharged stormwater to levels below effect levels for ESA listed species.
3. The USACE should encourage the applicant to develop a long-term plan to reduce the environmental impacts of their hard armoring and splash pad. Suggested measures include:
    a. Removal of all large stones;
    b. Replant natural plantings along the shoreline in the riparian belt;
    c. Replace the large river rock proposed in the action with smaller appropriately sized beach sand and small cobble.
4. Constrain in water work to those months least likely to have endangered rockfish species in the area.
    a. Rockfish work window: September 1 – April 30.

2.11 Re-initiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of the City of Tacoma's Hood Street outfall project in Pierce County, Washington. As 50 CFR 402.16 states, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitats in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitats that was not considered in this Opinion, or (4) a new species is listed or critical habitat is designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NOAA on all actions or proposed actions that may adversely affect essential fish habitat (EFH). The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 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) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. This analysis is based, in part, on the description of EFH for Pacific Coast salmon contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC 2014) and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in section 1 of this document. The waters and substrate of Commencement Bay and Foss waterway are designated as EFH for various life-history stages of Pacific Coast Salmon. EFH for Pacific salmon is identified and described in Appendix A in the Pacific Coast salmon fishery management plan (PFMC 2014).

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document describes the adverse effects of this proposed action on ESA-listed species and critical habitat, and is relevant to the effects on EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. Based on the analysis of effects presented in Section 2.5, the proposed action will cause small scale but chronic adverse effects on this EFH through direct and indirect physical, chemical, or biological alteration of the water and substrate, and through alteration of benthic communities, and the reduction in prey availability. Therefore, we have determined that the proposed action would adversely affect the EFH identified above.

3.3 Essential Fish Habitat Conservation Recommendations

The proposed action includes design features that are expected to reduce impacts on the quantity and quality of for Pacific Coast Salmon, Pacific Coast Ground fish, and Coastal Pelagic Species EFH. It also includes a conservation measure and BMP to minimize construction-related effects. While these conservation measures and BMPs are commendable, they are not sufficient to completely avoid or offset all effects to the listed EFH. Therefore, additional conservation recommendations pursuant to MSA (§305(b)(4)(A)) are necessary. The following conservation recommendations are prescribed:

1. The applicant should implement water treatment protocols and build infrastructure to reduce contaminant levels below detectable levels.
2. The applicant should work to reduce contaminants in the discharged stormwater to levels below effect levels for ESA listed species.
3. The COE should encourage the applicant to develop a long-term plan to reduce the environmental impacts of their hard armoring and splash pad. Suggested measures include:
    b. Removal of all large stones;
    c. Replant natural plantings along the shoreline in the riparian belt;
    d. Replace the large river rock proposed in the action with smaller appropriately sized beach sand and small cobble.
4. Constrain in water work to those months least likely to have rockfish species in the area.

a. Rockfish work window: September 1 – April 30.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the COE must provide a detailed response in writing to NOAA 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 NOAA' EFH Conservation Recommendations unless NOAA and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, 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 NOAA 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, NOAA 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 COE must reinitiate EFH consultation with NOAA 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 NOAA' 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 COE. Other users could include WA Dept. of Ecology, the governments and citizens of Pierce County and the City of Tacoma, the Puyallup Tribe, and other Native American Tribes. Individual copies of this Opinion were provided to the COE. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NOAA 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 NOAA ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

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

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

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

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Appendix A – Water Quality Monitoring

Goal and Objectives
The goal of the stormwater effectiveness monitoring study is to meet the requirements of the Endangered Species Act for WCR-2019-11312. The goals of both of these programs involve:

- Measuring the effectiveness of stormwater source control actions, confirming that reductions in concentrations of target analytes have been realized, and confirming that recontamination from stormwater sources is not occurring. This will be achieved by gathering data to identify trends in the quality of the stormwater;
- Providing an early indication of any new stormwater or sediment quality problems associated with the storm drains;
- Informing decision-making regarding additional source controls; and
- Tracing sources of contamination within drainage systems using sediment traps.

The objectives will be accomplished through performance of the following:

- Collect and submit for analysis representative composite and grab stormwater samples during stormflow events from all seven outfalls;
- Collect and submit for analysis representative annual sediment samples at specified monitoring locations;
- Produce an annual report documenting activities associated with the sampling and analysis effort, a quality assurance review of field and laboratory data, and an evaluation of the data relative to continuing source control efforts, and deliver the report to Ecology and EPA; and
- Enter all water and solids concentration data collected into the Ecology's Environmental Information Management (EIM) database pursuant to Appendix 9 of the Permit.

Study Deliverables
Each annual report will include all monitoring data collected during the preceding water year (October 1–September 30). Each report shall also integrate data from earlier years into the analysis of results, as appropriate. Reports shall be submitted on March 31st of each year[7] in both paper and electronic form to the NOAA Central Puget Sound branch.

Number of Samples:.
The city will collect 8 samples per year**,** the number of samples per year shall be modified over the course of the program based on the statistics from the previous years of monitoring.

Types of Samples: Monitoring will be conducted as follows:

1. Continuous flow monitoring at all sites.
2. Flow-weighted and time-weighted composite and grab samples of qualifying stormwater runoff for chemical analysis.

[7] The first annual monitoring report submitted under this QAPP on March 31, 2022 will include data from, October 1, 2020 through September 30, 2021. Subsequent reports will be submitted on March 31st of each year and will contain data for the preceding water year.

3. Annual sediment sampling for chemical analysis. (In-line sediment traps at five outfalls where feasible. Due to tidal conditions, a sediment trap cannot be placed in OF254. In OF245, an existing manhole with a sump will be used instead of a sediment trap).

Parameters: The Permit identifies stormwater quality analytes as parameters of concern based on the analytes that have a history of association with stormwater discharges and are expected to be found in urban environments. These analytes include conventional parameters, nutrients, metals, selected organics, fecal coliforms, and total petroleum hydrocarbons. Table 3-1, Table 3-2[8], and Table 3-3 contain lists of all parameters to be analyzed under either the Thea Foss Consent Decree or the Permit.

Analyte	Analysis Method
Conventionals	
Total Organic Carbon	9060 Mod
Grain Size	ASTM D422
Total Solids	SM 2540G
Total Volatile Solids	SM 2540G
Metals	
Total Cadmium	EPA 6020B
Total Copper	EPA 6020B
Total Lead	EPA 6020B
Total Mercury	EPA 7471B
Total Zinc	EPA 6020B
PAHs	
2-Methylnaphthalene	EPA 8270E SIM
Acenaphthene	EPA 8270E SIM
Acenaphthylene	EPA 8270E SIM
Anthracene	EPA 8270E SIM
Benzo(a)anthracene	EPA 8270E SIM
Benzo(a)pyrene	EPA 8270E SIM
Benzo(g,h,i)perylene	EPA 8270E SIM
Benzo(b,j,k)fluoranthenes[3]	EPA 8270E SIM
Chrysene	EPA 8270E SIM
Dibenz(a,h)anthracene	EPA 8270E SIM
Fluoranthene	EPA 8270E SIM
Fluorene	EPA 8270E SIM
Indeno(1,2,3-cd)pyrene	EPA 8270E SIM
Naphthalene	EPA 8270E SIM
Phenanthrene	EPA 8270E SIM
Pyrene	EPA 8270E SIM
Retene	EPA 8270E SIM
Phthalates	
Di(2-ethylhexyl)phthalate	EPA 8270E SIM
Butylbenzylphthalate	EPA 8270E SIM

[8] See Attachment 1 for Appendix 9 laboratory deviations for Bacteria (Table 3-1) and PCBs (Table 3-2).

Diethylphthalate	EPA 8270E SIM
Dimethylphthalate	EPA 8270E SIM
Di-n-butylphthalate	EPA 8270E SIM
Di-n-octyl phthalate	EPA 8270E SIM
Pesticides	
Bifenthrin	EPA 8270E SIM
Dichlobenil	EPA 8270E SIM
PCBs[4]	
Aroclors 1016, 1221, 1232, 1242, 1248, 1254 and 1260	EPA 8270E
Phenolics[5]	
Pentachlorophenol	EPA 8270E SIM
m,p-cresol (3,4-methylphenol)	EPA 8270E SIM
o-cresol (2-methylphenol)	EPA 8270E SIM
PBDEs	
PBDE 47, 49, 66, 71, 99, 100, 138, 153, 183, 184, 191	EPA 1614
PBDE 209	EPA 1614
Nutrients	
Total Phosphorus	SM4500P-F
Total Petroleum Hydrocarbons	
NWTPH-Diesel	NWTPH-Dx
NWTPH-Heavy Oil	NWTPH-Dx

Appendix B – Street Cleaning

Ferry Street Water Quality Device Cartridge Replacement

The Ferry Street water quality device replacement schedule occurs every 3 years. The media was replaced last year in 2019. In the next replacement cycle scheduled for 2022 it is the City's intent is to replace with an approved enhanced media.
The City will replace the 226 cartridges of the Ferry Street Facility (current media: CONTECH Engineered Solutions Stormwater Management StormFilter® , basic treatment) with CONTECH Engineered Solutions Stormwater Management StormFilter® with MetalRx™ media approved for Enhanced Treatment Performance.

Raingarden media replacement:

Once Ecology approves a new bioretention media mix for stormwater treatment, the City will evaluate replacing the media in the existing bioretention facilities in the Outfall 230 Basin (Pacific Avenue and Priarie Line Trail Facilities). Ecology's stormwater management manuals describe a default 60/40 bioretention soil mix (BSM) and list soil specifications for designers to create a custom filtration mix. In this study, collaborators from municipalities, academia, and the private sector developed and alternative BSM blends that do not leach phosphorus.

Storm Line Cleaning

The objective of the sewer line cleaning program was to remove residual sediments in the storm drains, some of which may contain legacy contamination from past years that may continue to contaminate stormwater or base flow through resuspension and/or dissolution.

While the City's Asset Management group has established a City-wide schedule of line cleaning every ten years, the Foss data will continue to be evaluated to determine whether more frequent cleaning is needed due to the sensitivity of the receiving water body. Below is the storm line cleaning schedule for the Thea Foss Basin. Total storm collection system to Thea Foss outfall: 122 miles (645,000 LF)

All of the pipes to Thea Foss Outfalls are scheduled to be cleaned between years 2020 – 2032.

<u>Planned cleaning schedule for Thea Foss:</u>

2021-2022 91,000 LF
2023-2024 198,000 LF
2025-2026 40,000 LF
2029-2030 254,000 LF
2031-2032 72,000 LF

Enhanced Street Sweeping

In January 2007, the City's street sweeping program was transferred from the Streets and Grounds division to the Sewer Transmission Maintenance section for continued implementation. The program was enhanced at that time in an attempt to reduce sediment buildup in the storm sewer system. The schedule was to sweep all areas of the City twice per year, with more frequent sweeping in the business districts and on major arterials. The 12 primary business districts in the City are swept at night two to three times per week and major arterials are swept on a 3-week rotation.

In 2007, when the work was transferred over, sweeping was done with a combination of mechanical and vacuum sweepers. In 2008, the City started the transition from mechanical sweepers to regenerative air machines. The City currently uses three regenerative air sweepers. GPS is used to track the number of miles swept and the amount of material removed is recorded. This effectiveness evaluation will continue to be updated as more post-enhanced sweeping data becomes available.

Appendix C – Tacoma Water Quality Monitoring Historic Data

Stormwater Analytical Data for Outfall 230 WY2017 - Composite Samples

	Storm 1 10/7/2016	Storm 2 10/15/2016	Storm 3 11/8/2016	Storm 4 Rejected 11/15/2016	Storm 5 12/4/2016	Storm 6 12/19/2016	Storm 7 1/8/2017	Storm 8 1/18/2017	Storm 9 2/4/2017	Storm 10 3/18/2017	Storm 11 4/6/2017	Storm 12 5/4/2017	Storm 13 6/16/2017	Storm 14 9/19/2017
Conventionals														
Anionic Surfactants - MBAS (mg/L)	–	51.1	–	25.0 UR	36.7	–	–	–	49.0 J	40.0	58.1	129	–	199
BOD (mg/L)	–	2.6	3.0	2.2 R	2.7	–	–	2.7 J	3.2	2.3	3.9	8.2	–	–
Chloride (mg/L)	–	1.65	–	0.891 R	2.65	–	–	–	30.1	2.09	2.07	2.89	–	8.20
Conductivity (uS/cm)	41.8	28.0	36.8	30.4 R	39.0	617	192	60.0	128	44.7	49.4	45.6	32.5	76.7
Hardness (mg CaCO3/L)	16.7	12.0	14.1	12.1 R	14.1	38.8	21.8	11.3	15.7	13.6	15.5	24.9	12.2	27.5
pH (pH Units)	7.3	6.3	6.9	7.7 R	6.8	7.8	7.0	7.0	7.1	7.2	7.6	7.3	7.1	7.2
Total Suspended Solids (mg/L)	43.4	60.2	40.6	22.0 R	13.9	17.2	46.6	36.4	19.2	18.6	12.2	183	23.1	103
Turbidity (NTU)	–	11.0	–	11.2 R	10.7	–	–	–	15.1 J	10.3	9.05	79.9	–	47.9
Nutrients														
Nitrate+Nitrite as N (mg/L)	–	0.150	0.160 J	0.120 R	0.096	–	0.115	0.113	0.156	0.099	0.172	0.239 J	0.203	0.426
Phosphate, Ortho (mg/L)	–	0.022	0.026	0.021 R	0.016	–	0.047	0.022 J	0.029 J	0.012	0.020	0.027	0.018	0.020
Phosphorus, Total (mg/L)	–	0.106	0.102	0.072 R	0.064	–	0.251	0.081	0.092	0.048	0.055	0.554	0.102	0.418
Total Nitrogen (mg/L)	–	0.33	0.47	0.23 R	0.29	–	1.07	0.31	0.53	0.28	0.48	0.86	0.66	2.10
Metals														
Cadmium (ug/L)	0.104 UJ	0.106 UJ	0.041 UJ	0.048 UJR	0.058 UJ	0.147 UJ	0.148 J	0.079 UJ	0.03 U	0.055 J	0.054 J	0.352 J	0.089 J	0.177 J
Cadmium, Dissolved (ug/L)	0.030 UJ	0.010 J	0.022 J	0.018 JR	0.033 UJ	0.109 UJ	0.040 J	0.024 UJ	0.061 U	0.050 U	0.050 U	0.050 U	0.050 U	0.066 J
Copper (ug/L)	12.3	9.15	5.44	5.41 R	4.51	8.22	13.9	7.35	6.87	7.14	8.46	41.4	12.3	39.6
Copper, Dissolved (ug/L)	5.16	2.49	2.30	1.67 R	2.07	4.62	3.92	2.24	3.77	2.61	5.28	6.24	6.89	18.1
Lead (ug/L)	11.9	12.0	5.90	8.01 R	4.46	5.77	15.7	8.24	4.32	7.39	4.94	64.9	6.81	25.5
Lead, Dissolved (ug/L)	0.604	0.305	0.401	0.299 R	0.280	0.396	0.307	0.244	0.312	0.257	0.475	0.739	0.516	1.30
Mercury (ng/L)	6.4	2.8 J	3.5 J	4.6 JR	3.3 J	3.9 J	5.7	4.2 J	2.4 J	6.0 J	9.0 J	5.5 J	6.5 J	10.1
Mercury, Dissolved (ng/L)	2.0 J	1.8 U	1.8 U	1.8 UR	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	9.0 U	9.0 U	9.0 UJ	9.0 U	3.5 J
Zinc (ug/L)	96.9	75.8	37.2	40.4 R	52.4	102	110	57.3	60.4	48.3	56.7	231	70.8	200
Zinc, Dissolved (ug/L)	49.7	34.2	23.6	20.6 R	38.0	77.3	44.1	29.1	44.8	28.1	41.1	38.7	44.4	97.0
Insetcticides														
Carbaryl (ug/L)	–	0.50 U	0.50 U	0.50 UR	0.50 U	–	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U	0.50 U
Chlorpyrifos (ug/L)	0.017 U	0.017 U	0.006 U	0.006 UJR	0.017 U	0.020 U	0.006 U	0.006 U	0.006 UJ	0.006 U	0.017 U	0.060 U	0.061 U	0.060 U
LPAHs														
2-Methylnaphthalene (ug/L)	0.008 U	0.009 J	0.005 UJ	0.005 UJR	0.040 J	0.014	0.026	0.014	0.020 J	0.009 J	0.008 U	0.007 J	0.003 U	0.013
Acenaphthene (ug/L)	0.006 U	0.006 U	0.004 UJ	0.004 UJR	0.006 UJ	0.007 U	0.004 U	0.006 J	0.005 J	0.007 J	0.012	0.005 U	0.005 U	0.005 UJ
Acenaphthylene (ug/L)	0.006 U	0.006 U	0.005 J	0.004 JR	0.006 UJ	0.007 U	0.011	0.008 J	0.006 J	0.004 J	0.006 U	0.006 J	0.003 U	0.003 U
Anthracene (ug/L)	0.005 U	0.008 J	0.006 J	0.007 JR	0.006 J	0.006 U	0.007 J	0.007 J	0.008 J	0.005 UJ	0.005 U	0.015	0.006 U	0.006 U
Fluorene (ug/L)	0.006 U	0.006 U	0.006 J	0.007 JR	0.013 J	0.008 U	0.014	0.010 J	0.009 J	0.006 J	0.006 U	0.010 J	0.006 J	0.005 U
Naphthalene (ug/L)	0.014 J	0.016 J	0.017 UJ	0.014 UJR	0.021 J	0.029	0.072	0.045 UJ	0.026 UJ	0.020 J	0.019	0.017	0.012 UJ	0.023 J
Phenanthrene (ug/L)	0.031	0.055	0.024 J	0.041 JR	0.048 J	0.037	0.064	0.051	0.058 J	0.028 J	0.023	0.099	0.038	0.040
Total LPAHs	0.0565	0.088	0.0515	R	0.094	0.08	0.17	0.1045	0.099	0.0675	0.0625	0.1495	0.057	0.0725
HPAHs														
Benzo(a)anthracene (ug/L)	0.019	0.045	0.018	0.038 JR	0.024 J	0.011 J	0.029	0.030	0.028 J	0.020	0.009 J	0.079	0.019	0.016
Benzo(a)pyrene (ug/L)	0.028	0.063	0.025	0.052 JR	0.031 J	0.013	0.036	0.039	0.033 J	0.029	0.014	0.107	0.026	0.025
Benzo(b,k)fluoranthene (ug/L)	0.081	0.202	0.053	0.108 JR	0.079 J	0.036	0.081	0.085	0.078 J	0.061	0.035	0.256	0.068	0.073
Benzo(g,h,i)perylene (ug/L)	0.027	0.050	0.034	0.048 JR	0.027 J	0.019	0.052	0.047	0.047 J	0.055	0.013	0.082	0.018	0.015
Chrysene (ug/L)	0.053	0.104	0.030	0.063 JR	0.051 J	0.026	0.051	0.056	0.057 J	0.042	0.025	0.149	0.024	0.049
Dibenz(a,h)anthracene (ug/L)	0.006 J	0.011	0.008 J	0.014 JR	0.006 J	0.003 U	0.011	0.011	0.010 J	0.012	0.003 U	0.022	0.004 U	0.005 J
Fluoranthene (ug/L)	0.063	0.121	0.043	0.086 JR	0.060	0.034	0.082	0.082	0.074 J	0.049	0.030	0.207	0.062	0.059
Indeno(1,2,3-c,d)pyrene (ug/L)	0.021	0.048	0.034	0.051 JR	0.023	0.011 J	0.042	0.041	0.035 J	0.044	0.009 J	0.092	0.013	0.015
Pyrene (ug/L)	0.059	0.107	0.043	0.084 JR	0.081 J	0.044	0.093	0.084	0.089 J	0.056	0.039	0.198	0.061	0.058
Total HPAHs	0.357	0.751	0.288	R	0.382	0.1955	0.477	0.475	0.451	0.368	0.1755	1.192	0.293	0.315
TOTAL PAHs	0.4135	0.839	0.3395	R	0.476	0.2755	0.647	0.5795	0.55	0.4355	0.238	1.3415	0.35	0.3875
Phthalates														
Bis(2-ethylhexyl) phthalate (ug/L)	1.88	1.90	2.30	1.96 R	1.89	1.67	2.68	2.24	2.74 J	2.26	2.14	2.75	3.20	2.90
Butyl benzyl phthalate (ug/L)	0.603 U	0.603 U	0.206 J	0.267 JR	0.603 U	0.721 U	0.344 J	0.220 J	0.321 J	0.268 J	0.582 U	0.433 J	0.434 U	0.430 U
Diethyl phthalate (ug/L)	0.520 U	0.520 U	0.546 J	0.344 JR	0.520 U	0.622 U	0.400 J	0.157 U	0.268 J	0.257 J	0.502 U	0.439 J	0.283 U	0.280 U
Dimethyl phthalate (ug/L)	0.455 U	0.455 U	0.077 UJ	0.077 UJR	0.455 U	0.544 U	0.077 U	0.077 U	0.077 UJ	0.076 UJ	0.439 U	0.270 U	0.273 U	0.270 U
Di-n-butyl phthalate (ug/L)	0.508 U	0.508 U	0.300 J	0.273 JR	0.508 U	0.607 U	0.355 J	0.230 J	0.376 J	0.323 J	0.491 U	0.290 U	0.293 U	0.290 U
Di-n-octyl phthalate (ug/L)	0.501 J	0.464 J	0.468 J	0.406 JR	0.403 J	0.410 U	0.564 J	0.367 J	0.575 J	0.580 J	0.611 J	0.466 J	1.08	1.52
Total Phthalates	2.381	2.364	3.82	R	2.293	1.67	4.343	3.057	4.28	3.688	2.751	4.088	4.28	4.42
Herbicides														
2,4-D (ug/L)	–	0.12	0.069 J	0.17 JR	0.045 J	–	0.036 J	0.018 U	0.10 J	0.023 J	0.60	0.47	0.46	–
Dichlobenil (ug/L)	0.021 J	0.020 U	0.017 J	0.012 JR	0.023 J	0.024 U	0.023 J	0.016 J	0.064 J	0.162 J	0.053 J	0.091 J	0.055 J	0.040 U

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Table D-1.2
Stormwater Analytical Data for Outfall 230 WY2017 - Grab Samples

Table D-1.2
Stormwater Analytical Data for Outfall 230 WY2017 - Grab Samples

	10/4/2016	10/13/2016	11/5/2016	1/7/2017	2/3/2017	2/15/2017	3/13/2017	4/5/2017	5/11/2017	6/15/2017
TPH										
NWTPH-Diesel (mg/L)	**0.13** J	0.10 UJ	**0.11**	0.10 U	0.10 U	0.10 UJ	0.10 UJ	0.10 U	0.10 U	**Unusable** R
NWTPH-Gasoline (ug/L)	50.0 U	50.0 U	50.0 U	50.0 U	50.0 U	50.0 U	50.0 U	50.0 U	50.0 U	50.0 U
NWTPH-Heavy Oil (mg/L)	**0.76** J	**0.54** J	**0.78** J	**1.4**	**1.3**	**0.59** J	**0.50** J	**0.53**	**0.67**	**Unusable** R
Bacteria										
Coliform, Fecal (CFU/100mL)	**16,000** E	**9,200**	**16,000** E	**5,400**	**2,400**	**3,500**	**790**	**2,800**	**16,000**	**3,500**
BTEX										
Benzene (ug/L)	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Ethylbenzene (ug/L)	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
m,p-Xylene (ug/L)	0.4 U	0.4 U	0.4 U	0.4 U	0.4 J	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
o-Xylene (ug/L)	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Toluene (ug/L)	**0.5** J	0.2 J	0.2 U	0.2 U	0.2 J	0.2 U	0.2 U	0.2 U	**0.3** J	0.2 J

Bold – The analyte was present in the sample.
U – The analyte was not detected at or above the reported value.
UJ – The analyte was not detected at or above the reported estimated value.
J – The analyte was positively identified. The associated value is an estimate.
R – The value is considered unusable.
E - Exceeds value.

Appendix D – Habitat Equivalency Analysis

Summary of Parameters Needed for HEA

Red cells are transferred from other worksheets.

Nearshore Habitat Values Results	Before	After	Area	Delta
Riparian	0.0000	0.0000	0.0000	0.0000
Upper Shore Zone PRF	0.4494	0.3281	0.0438	-0.1212
Lower Shore Zone PRF	0.3571	0.0000	0.0006	-0.3571
Deeper Zone	0.2500	0.2500	0.0006	0.0000
	Values transferred from previous worksheets.			Improvements: delta > 0
				Function Loss: delta < 0

HEA Results	Years project exists	DSAYs	
Riparian	300	0.0000	Values transferred from "DSAY calc" worksheet.
Upper SZ	50	-0.2052	
Lower SZ	50	-0.0089	
Deeper Zone	300	0.0000	
Sum		-0.2140	

Shade and Over Water Structures – Upper Shore Zone

	Before				After			
	sqft	acres	percent shading/impact	Assumption: at 100% shading there is 10 % residual value.	sqft	acres	percent shading/impact	Assumption: at 100% shading there is 10 % residual value.
4-ft Piers, fully grated	0	0	0	0	0	0.00	0	
Wider Piers, not fully grated OWS	0	0	0	0	0	0.00	0	
Buffer - not for fully grated piers	0	0	0	0	0	0.00	0	
Float area	0	0	0	0.63	0	0.00	0	
Boats	0	0	0	0.9	0	0.00	0	
Buffer Float, 10 ft	0	0	0	0.45	0	0.00	0	
Prop Scour area	0	0	0	n/a	140	0.00	1	
Rest of considered effected area								
sum								

Habitat Characteristics Impact – Upper Shore Zone

	For any variables that receive the same value before and after project impact, don't be too concerned about the exact rating, make sure that it is the same n the before and after spreadsheet.		Upper Shore Zone Affected Area		needs to be same for before and after
			sqft	acres	
I	Length (along shoreline) of area affected in the long term by project. For a boat ramp this likely is downdrift part of drift cell. [ft]	191.00	1910.00	0.04	
II	Width of Upper Shore Zone, again area impacted in long-term by project, often MHHW to +5 MLLW [ft].	10.00	Filling in C7 is not needed if D6 is entered directely.		

#	Indicator of Physical Habitat	Question	Maximum Possible Points	Before: Site Condition	Before: Project Points	Before: Summary Project Points by Category	After: Site Condition	After: Project Points	After: Summary Project Points by Category
Shoreline Conditions									
1	Shoreline Condition	What percent [0 to 100%] of bankline of the action area is fully functional, with soft or natural bank? For bioengineered banks enter overall percent of function compared to unstabilized natural shoreline.	3	40	1.20	1.20	50	1.50	1.50
Shallow Water Habitat									
2a	Shallow Water Habitat, Accessibility and Presence	What shallow water area [in sqft] is lost to juvenile rearing? This loss could be the result of the construction of three-dimensional structures that result in the loss of shallow water habitat during some tides. Such structures include piles, bulkheads, and fill, or the conversion of shallow water habitat to deep water habitat via dredging. Not included as impacts to this habitat parameter are low profile structures like boat ramps, rails, and low concrete rubble. The effect of boat ramps and debris are considered with the Substrate rating below.	4	0.00	4.00		620.00	2.701570681	
2b	Dredging	Is habitat loss dredging related? Y or N. If so, 50% of habitat points are awarded since habitat is not completely gone, but converted to deeper habitat.		n	4.00		n	2.70	
2c	Shading from OWS	Discounting factor, proportional to shading, determined in "Shade Imp LSZ" tab.		1.00	4.00	4.00	1.00	2.701570681	2.701570681
Beach Logs									
3	Habitat Function from Large Wood	Enter the percent of function beach logs provide compared to the ideal, best case scenario for the project area [0 to 100%]. See description of beach logs in guidance for help. Enter 0 for no beach logs, 5 for 5%.	1	15	0.15	0.15	40.00	0.40	0.40
Substrate/Sediment									
4a	Substrate Size select one	Is the surface substrate in the littoral zone of the action area >25% mud or mixed fines?	2	n	0.00		n	0.00	
4b		Is the surface substrate in the littoral zone of the action area >25% sand or larger grained gravels?	3	n	0.00		n	0.00	
4c		Is the surface substrate in the littoral zone of the action area >25% rocky?	3	y	3.00	3.00	y	3.00	3.00
4d	Habitat Loss from Development	**Sediment lost to low and high structures:** What area [in sqft] is lost to structures including boat ramps, riprap, concrete rubble, jetties, and bulkheads.		573.00	2.10		1084.00	1.30	
4e	Habitat Degradation Resulting from Development	**Habitat Reduction:** Enter % habitat reduction [0 to 100%] for etire affected area not covered up by low structures. Is the substrate in the affected area unnaturally compacted or		60.00	0.84		50.00	0.65	
4f	Shading from OWS applies to sediment only if vegetation < 40%	**Discounting factor** proportional to shading from pier, see Shade Impact USZ PRF worksheet. However, shading is assumed to affect sediment, only, if there is little vegetation (score 0)) otherwise factor 1 (no discount) is assigned.		1.00		0.84	1.00		0.648691099
Vegetation									
5a	Vegetation Condition, select one	Enter "Y" in column D if your affected area is covered with >60% of upper intertidal vegetation including macro algae and saltmarsh vegetation like Salicornia sp. and Disticilis sp..	3	n	0.00		n	0.00	
5b		Upper intertidal vegetation including macro algae and saltmarsh vegetation like Salicornia and Disticilis <40%	0	y	0.00	0.00	y	0.00	0.00
5c	Shading from OWS	Discounting factor proportional to shading from p er, see "Shade&Str Imp USZ (before)" worksheet.		1.00		0.00	0.93		0.00
Water Qual ty									
6a	Water Quality Condition select one	Is water quality in action area optimal? Use location as surrogate if no data. If action area is in undeveloped part of Puget Sound choose "yes"	2	n	0.00		n	0.00	
6b		Is water quality in action area free of major contaminants associated with industrial and urban development like harbors, water treatment plants, and untreated storwater inputs? Use location as surrogate if no data. If action area is in little to medium developed part of Puget Sound, like Wollochet Bay, Horshead Bay, Gig Harbor, choose "yes"	1	y	1.00		n	0.00	
6c		Is WQ impacted by major contaminants associated with industrial and urban development like harbors, water treatment plants, and untreated storwater inputs? Use location, as surrogate if no data. If action area is very developed and has WQ effects from industrial sources, like Commencement Bay, Duwamish, choose "yes".	0	n	0.00	1.00	y	0.00	0.00
		Sum of maximum possible points	16		Site Points Before	7.19		Site Points After	5.25
					NHV	0.45		NHV	0.33

Habitat Characteristics Impact – Lower Shore Zone

				Before			After		
#	**Indicator of Physical Habitat**	**Question**	**Maximum Possible Points**	**Site Condition**	**Project Points**	**Summary Project Points by Category**	**Site Condition**	**Project Points**	**Summary Project Points by Category**
Submerged Aquatic Vegetation (SAV)									
1a	**SAV condition, select one**	Aquatic vegetation value high	4	n	0		n	0	
1b		Aquatic vegetation value medium, incl. native oyster beds	3	n	0		n	0	
1c		Aquatic vegetation value medium low	2	n	0		n	0	
1d		Aquatic vegetation value very low	1	n	0		n	0	
1e		Aquatic vegetation value none	0	y	0	0	y	0	0
1	**Shading from OWS**	Discounting factor, proportional to shading and prop scour impact, determined in "Shade Imp LSZ" tab.		1.00		0	1.00		0
Shallow Water Habitat									
2a	**Shallow Water Habitat, Accessibility and Presence**	What shallow water area [in sqft] is lost to juvenile rearing? This loss could be the result of the construction of three-dimensional structures that result in the loss of shallow water habitat during some tides. Such structures include piles, bulkheads, and fill, or the conversion of shallow water habitat to deep water habitat via dredging. Not included as impacts to this habitat parameter are low profile structures like boat ramps, rails, and low concrete rubble. The effect of boat ramps and debris are considered with the Substrate rating below.	1.00	0	1.00		28.00	0.00	
2b	**Dredging**	Is habitat loss dredging related? Y or N. If so, NHV for LSZ gets multiplied with 0.3, because maximum habitat value for deeper habitat is 0.3.		n	1.00		n	0.00	
2c	**Shading from OWS**	Discounting factor, proportional to shading, determined in "Shade Imp LSZ" tab.		1.00		1	1.00		0.00
Sediment									
3a	**Substrate Size select one**	Is the surface substrate in the littoral zone of the action area >25% mud or mixed fines?	0.5	n	0.00		n	0	
3b		Is the surface substrate in the littoral zone of the action area >25% sand or larger grained gravels?	1	n	0.00		n	0	
3c		Is the surface substrate in the littoral zone of the action area >25% rocky?	1	y	1.00	1.00	y	1	1
	Habitat Loss from Development	**Sediment lost to low and high structures:** What area [in sqft] is lost to structures including boat ramps, riprap, concrete rubble, jetties, and bulkheads.		0	1.00		28	0.00	
3d	**Habitat Degradation Resulting from Development**	**Habitat Reduction**: Enter % habitat reduction [0 to 100%] for etire affected area not covered up by low structures. Is the substrate in the affected area unnaturally compacted or coarsened as a result of a bulkhead or riprap; has the beach grade lowered? Consider effects within the effected area, only, like downdrift part of drift cell. This is the area calculated in B10 of the "Shade Imp LSZ" tab.		0	1.00		15	0.00	
3e	**Shading from OWS**	**Discounting factor** for OWS, proportional to shading and prop scour, see Shade Impact PRF worksheet. This factor applies only, if vegetation value <2. Otherwise we assume that most of the shade impact comes to bear on the vegetation.		1.00		**1.00**	1.00		0.00
Water Quality									
4a	**Water Quality Condition, select one**	Is water quality in action area optimal? Use location as surrogate if no data. If action area is in undeveloped part of Puget Sound choose "yes"	1	n	0.00		n	0.00	
4b		Is water quality in action area free of major contaminants associated with industrial and urban development like harbors, water treatment plants, and untreated storwater inputs? Use location as surrogate if no data. If action area is in little to medium developed part of Puget Sound, like Wollochet Bay, Horshead Bay, Gig Harbor, choose "yes"	0.5	y	0.50		n	0.00	
4c		Is WQ impacted by major contaminants associated with industrial and urban development like harbors, water treatment plants, and untreated storwater inputs? Use location, as surrogate if no data. If action area is very developed and has WQ effects from industrial sources, like Commencement Bay, Duwamish, choose "yes".	0	n	0.00	**0.50**	y	0.00	0
		Sum of maximum possible points	**7.00**		**Site Points Before**	**2.50**		**Site Points After**	**0.00**
					NHV	**0.36**		NHV	**0.00**

Discounted Service Acre years calculation – Upper Shore Zone

Initial Value of Habitat:			0.449375
Years to a Fully Functioning Habitat:			1
Base Year:			0
Discount Rate			0.03
# Years Project Exists:			50
Value of Post-Construction Habitat:			0.328141361
Delta Habitat Values			-0.121233639
Acres of Habitat:			0.043847567
		Enter Y/N	
Crediting or Discounting Factors	Is there potential forage fish spawning on-site?	n	1
	Is affected area in a pocket estuary, bluff backed beach, or pocket beach?	n	1
	Is affected area within 5 miles of an estuary of a Chinook or HC summer chum bearing stream?	y	1.5
TOTAL DSAYs: -0.205			

Discounted Service Acre years calculation – Lower Shore Zone

Initial Value of Habitat:				0.36
Years to a Fully Functioning Habitat:				1
Base Year:				0
Discount Rate				0.03
# Years Project Exists:				50
Value of Post-Construction Habitat:				0.00
Delta Habitat Values				-0.357142857
Acres of Habitat:				0.000642792
			Enter Y/N	
Crediting or Discounting Factors		Is there potential herring spawning on-site?	n	1
		Is affected area in a pocket estuary, bluff backed beach, or pocket beach?	n	1
		Is affected area within 5 miles of an estuary of a Chinook or HC summer chum bearing stream?	y	1.5
TOTAL DSAYs:	**-0.009**			