# BIOLOGICAL EVALUATION
# AND ESSENTIAL FISH HABITAT ASSESSMENT

*for Endangered Species Act Section 7 Consultation on*

## NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) MUNICIPAL STORMWATER PERMITS LOCATED IN THE LEWISTON, IDAHO URBANIZED AREA:

*City of Lewiston & Lewis-Clark State College (NPDES Permit No. IDS028061)*
*Idaho Transportation Department District #2 (NPDES Permit No. IDS028258)*

United States Environmental Protection Agency

***Prepared by:***

***U.S. Environmental Protection Agency, Region 10***

*Laboratory Services and Applied Sciences Division and*
*Water Division*

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# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| 7DADM | 7-Day Average Daily Maximum |
| 7Q10 | 7-Day, 10 Year Low Flow |
| ACM | Alternative Control Measure |
| ACR | Acute-Chronic Ratios |
| BE | Biological Evaluation |
| BMP | Best Management Practice |
| BOD | Biochemical Oxygen Demand |
| CaCO3/L | Calcium Carbonate per Liter |
| CCC | Criterion Continuous Concentration |
| CFR | Code of Federal Regulations |
| CMC | Criterion Maximum Concentration |
| CN | Curve Number |
| COD | Chemical Oxygen Demand |
| COM | Commercial |
| C-R | Concentration-Response |
| CWA | Clean Water Act |
| DART | Columbia River Data Access in Real Time database |
| DES | Western Desert |
| DO | Dissolved Oxygen |
| DOC | Dissolved Organic Carbon |
| DPS | Distinct Population Segment |
| EC | Effect Concentration |
| EC10 | 10 Percent Effect Concentration |
| EFH | Essential Fish Habitat |
| EoP | End of Pipe |
| EPA | Environmental Protection Agency |
| EPC | Exposure Point Concentration |
| EqP | Equilibrium Partitioning |
| ERA | Ecological Risk Assessment |

| | |
|---|---|
| ESA | Endangered Species Act |
| ESU | Evolutionary Significant Unit |
| FCV | Final Chronic Value |
| FMP | Fishery Management Plans |
| FR | Federal Register |
| GMAV | Genus Means Acute Values |
| GMCV | Genus Means Chronic Values |
| HDR | High Density Residential |
| HQ | Hazard Quotient |
| HUC | Hydrologic Unit Code |
| IC | Interior Columbia Recovery Domain |
| IC25 | 25 Percent Inhibition Concentration |
| ID | Idaho |
| IDEQ | Idaho Department of Environmental Quality |
| IDFG | Idaho Department of Fish and Game |
| IND | Industrial |
| ITD2 | Idaho Transportation Department District #2 |
| LC5 | 5 Percent Lethal Concentration |
| LC50 | 50 Percent Lethal Concentration |
| LCSC | Lewis-Clark State College |
| LDR | Low Density Residential |
| LGDP | Lower Granite Dam Pool |
| LLPs | Lewiston Levee Ponds and Pumping Stations |
| LOEC | Lowest Observed Effect Concentration |
| MATC | Maximum Acceptable Toxicant Concentration |
| MCR | Middle Columbia River |
| MDL | Minimum Detection Limit |
| MEP | Maximum Extent Practicable |
| MLR | Multiple Linear Regression |
| MRL | Method Reporting Limit |
| MS4 | Municipal Separate Storm Water Sewer System |

| | |
|---|---|
| MSFCMA | Magnuson-Stevens Fishery Conservation and Management Act |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NOEC | No Observed Effect Concentration |
| NOEL | No Observed Effect Limit |
| NPDES | National Pollutant Discharge Elimination System |
| O&M | Operations and Maintenance |
| OPEN | Parks/Open Space/Residential |
| PAHs | Polyaromatic Hydrocarbons |
| PBFs | Physical or Biological Features |
| PCBs | Polychlorinated Biphenyls |
| PCDDs | Polychlorinated Dibenzo-p-dioxins |
| PCDFs | Polychlorinated Dibenzofurans |
| PCE | Primary Constituent Elements |
| PCLEL | Prey Category Low Effect Level |
| PIT | Passive Integrated Transponder |
| PTAGIS | Passive Integrated Transponder Tag Information Systems |
| RPA | Reasonable and Prudent Alternative |
| SAR | Smolt to Adult Return Rates |
| SLEL | Salmonid Low Effect Level |
| SMAV | Species Mean Acute Values |
| SMCV | Species Mean Chronic Values |
| SR | Snake River |
| SRB | Snake River Basin |
| SWMP | Stormwater Management Program |
| SWPPP | Stormwater Pollution Prevention Plan |
| T&E | Threatened and Endangered |
| TAF | Taxonomic Adjustment Factor |
| THg | Total Inorganic Mercury |
| TKN | Total Kjeldhal Nitrogen |
| TMDL | Total Maximum Daily Load |

| | |
|---|---|
| TOC | Total Organic Carbon |
| TP | Total Phosphorus |
| TR | Technical Release |
| TSS | Total Suspended Solids |
| TVS | Total Volatile Solids |
| UA | Urbanized Area |
| US | United States |
| USACE | United States Army Corps of Engineers |
| USC | United States Code |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| WQC | Water Quality Criterion |
| WQS | Water Quality Standards |

# UNITS

| | |
|---|---|
| cfs | Cubic feet per second |
| cm | Centimeters |
| ºC | Degrees Celsius |
| ºF | Degrees Fahrenheit |
| ft | Feet |
| $ft^2$ | Square feet |
| gpd | Gallons per day |
| hrs | hours |
| in | Inches |
| kg | Kilogram |
| km | Kilometers |
| $km^2$ | Square kilometers |
| m | Meters |
| mgd | Million gallons per day |
| min | minutes |
| mg/L | Milligrams per liter |
| mg/kg | Milligrams per kilogram |
| mi | Miles |
| $m^3/s$ | Cubic meter per second |
| $mi^2$ | Square miles |
| ng/L | Nanograms per liter |
| oz | Ounce |
| ppb | Parts per billion |
| rkm | River kilometer |
| µg/L | Micrograms |

# 1. INTRODUCTION AND PROJECT BACKGROUND

The U.S. Environmental Protection Agency (EPA) Region 10 is proposing to issue, for the first time, two National Pollutant Discharge Elimination System (NPDES) permits ("the Permits" or "EPA's Permit Actions") for stormwater discharges from municipal separate storm sewer systems (MS4s) owned and/or operated by the City of Lewiston (City), Lewis-Clark State College (LCSC; NPDES Permit No. IDS028061), and Idaho Transportation Department District #2 (ITD2; NPDES Permit No. IDS028258) in the Lewiston, Idaho, Urbanized Area (UA). These parties are collectively referred to in this document as the "Permittees" or "the MS4s." The two Permits will authorize discharges from the MS4s into the Snake River, the Lewiston Levee Ponds and Pumping Stations (LLPs), Lower Granite Dam Pool (LGDP), Snake River, Tammany Creek, and Lindsay Creek. EPA developed the Permits pursuant to the provisions of the Clean Water Act (CWA), 33 U.S.C. § 1251 *et seq*. and the NPDES regulations at 40 CFR Parts 122, 123 and 124.

This Biological Evaluation (BE) was developed to assist with consultations with the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) on the Permits, as required under Section 7 of the Endangered Species Act (ESA) and Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). USFWS and NMFS are collectively referred to in this document as *the Services*.

The BE describes the receiving environment and potential consequences of EPA's Permit Actions to ESA-listed fish, wildlife and designated critical habitat that may be present in the Action Area. The BE evaluates the species and critical habitats under the jurisdiction of both USFWS and NMFS and evaluates the potential for adverse effect on Essential Fish Habitat (EFH) resulting from issuance of the Permits.

## 1.1 ENDANGERED SPECIES ACT

The ESA (16 U.S.C. § 1531 et al.) requires federal agencies to consult with the Services if the federal agency's actions could beneficially or adversely affect any threatened and endangered species or their critical habitat. In this case, the federal agency is EPA, and the discretionary action is the issuance of two NPDES permits for discharges from the MS4s in the Lewiston UA. A BE provides an analysis of the potential consequences of a proposed federal agency action on any proposed and listed species or the designated critical habitat of any such species based on the best scientific or commercial information available.

## 1.2 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSFCMA (U.S.C. § 1801 et al.) established regional Fishery Management Councils and mandated that Fishery Management Plans (FMPs) be developed to responsibly manage exploited fish and invertebrate species in federal waters of the United States.

MSFCMA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), charged NMFS with designating and conserving EFH for species managed under existing FMPs. This requirement is intended to minimize, to the extent practicable, any adverse effects on habitat caused by fishing or non-fishing activities, and to identify other actions to encourage the conservation and enhancement of such habitat. Federal action agencies that may adversely impact EFH are required to consult with NMFS regarding the potential effects of their actions on EFH and respond in writing to the fisheries service's recommendations. The accompanying EFH analysis can be found in Section 8.

## 1.3 FEDERAL ACTION AND CONSULTATION HISTORY

The Permittees discharge stormwater to waters of the United States from their MS4s in the Lewiston UA, Nez Perce County, Idaho. See Section 2.3.

Since this is the first time EPA will issue NPDES permits for the regulated MS4s owned and/or operated by the Permittees, this will be the first time that EPA has consulted on these permits under the ESA or the EFH provisions of the MSFCMA. However, the project has a long history, and EPA has coordinated with the Services to discuss ESA and EFH consultation issues for these Permits.

The City and ITD2 each submitted NPDES permit applications to EPA in 2003. In 2003 and 2005, EPA confirmed species lists for Nez Perce County from the Services. In August 2007, EPA proposed for public comment draft NPDES permits for the City and ITD2; however, these permits were never issued as final. In January 2011, LCSC submitted a permit application to EPA, which was later amended in 2012 when the City and LCSC requested that EPA include both entities under one permit as co-permittees.

In late 2018, EPA proposed to issue two NPDES permits: one permit for the City and LCSC as co-permittees (NPDES Permit No. IDS028061) and a separate permit to ITD2 (NPDES Permit No. IDS028258). The public comment periods for the permits ended on March 22, 2019. In January 2020 and July 2020, EPA reconfirmed the ESA species lists with the Services. See Section 3.1. The final proposed Permits are included in this BE as Appendices 1 and 2, respectively.

# 2. DESCRIPTION OF ACTIONS AND ACTION AREA

The federal actions are EPA's proposed issuance of two NPDES Permits for discharges from small MS4s owned and/or operated by the City/LCSC and ITD2, respectively.

A "MS4" is defined at 40 CFR § 122.26(b)(8) as

> "*a conveyance or system of conveyances (…roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body …having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes… that discharges to waters of the United States; (ii) Designed or used for collecting or conveying stormwater; (iii) Which is not a combined sewer; and (iv) Which is not part of a Publicly Owned Treatment Works… as defined at 40 CFR § 122.2.*"

The NPDES permits that EPA proposes to issue establish conditions, prohibitions and management practices for discharges of stormwater from these small MS4s and requires the Permittees to implement comprehensive stormwater management programs (SWMPs) to reduce the discharge of pollutants from the MS4s to the maximum extent practicable (MEP), to protect water quality, and to satisfy the appropriate water quality requirements of the CWA.

EPA's legal authority and permitting objectives for MS4 discharges are explained in Section 2.1; Section 2.2 describes the basis for the provisions of the Permits that comprise the Actions, and Section 2.3 describes the Action Area.

## 2.1 LEGAL AUTHORITY FOR THE ACTIONS

Section 301(a) of the CWA, 33 U.S.C. § 1311(a), provides that the point source discharge of pollutants to surface waters of the United States is unlawful except in accordance with, among other things, an NPDES permit. Receiving waters for the MS4 discharges to be covered by EPA's Permit Actions are waters of the U.S. and include all surface waters receiving stormwater discharges from the MS4s described in this BE.

The NPDES permitting program is authorized by Section 402 of the CWA, 33 U.S.C. § 1342, and implemented by regulations set forth in Title 40 of the Code of Federal Regulations (CFR) Parts 122, 123 and 124. NPDES permits are written for, at most, five-year permit terms, and subsequently reissued consistent with regulations, discharge characteristics, and/or receiving water status, including applicable water quality standards. EPA Region 10 is the NPDES permitting authority for regulated stormwater discharges in the State of Idaho until July 1, 2021 when the Idaho Department of Environmental Quality (IDEQ) will become the permitting authority.

### 2.1.1 Federal NPDES Permit Objectives for MS4 Discharges

EPA's Permit Actions are based on CWA Section 402(p) of the CWA, 33 U.S.C. § 1342(p), and EPA regulations for permitting municipal stormwater discharges.[1] CWA Section 402(p)(3)(B), 33 U.S.C. §1342(p)(3)(B), specifies that NPDES permits for discharges from MS4s:

*(i)* *may be issued on a system- or jurisdiction-wide basis;*
*(ii)* *shall include a requirement to effectively prohibit non-stormwater discharges into the storm sewers, and*
*(iii)* *shall require controls to reduce the discharge of pollutants to the maximum extent practicable [MEP], including management practices, control techniques, and system, design and engineering methods, and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants.*

Pursuant to CWA Section 402(p)(6), 33 U.S.C. § 1342(p)(6), in 1999, EPA subsequently issued the "Phase II" stormwater regulations to expand the types of stormwater discharges that must comply with NPDES permits to include discharges from "small MS4s" (i.e., those MS4s located within the U.S. Bureau of Census-defined UAs according to the latest Decennial Census) (40 CFR §§122.30-37). Based on their geographic locations in the Lewiston, Idaho UA, the MS4s owned and/or operated by the Permittees are considered "small MS4s," and must be controlled in compliance with an appropriate NPDES permit.[2]

All NPDES permits for small MS4 discharges must require, at a minimum, that the operator develop, implement, and enforce a comprehensive SWMP designed to reduce the discharge of pollutants from the MS4 to the MEP, to protect water quality, and to satisfy the appropriate water quality requirements of the CWA (40 CFR § 122.34). Small MS4 permits must contain prescriptive requirements detailing the explicit expectations for each of the six "minimum control measures" described in 40 CFR § 122.34(b), namely: public education; public involvement; illicit discharge detection and elimination; construction site runoff control; post construction stormwater runoff control; and pollution prevention/good housekeeping for municipal operations.

40 CFR § 122.34(a) also states that terms and conditions of small MS4 permits may include "narrative, numeric, or other types of requirements (e.g., implementation of specific tasks or best management practices (BMPs), BMP design requirements, performance requirements, adaptive management requirements, schedules for implementation and maintenance, and frequency of actions."

[1] 40 CFR §§ 122.26, and 122.30-35. See also 55 Federal Register 47990 [Nov. 16, 1990], 64 FR 68722 [Dec. 8, 1999], and 81 FR 89320 [Dec. 9, 2016], respectively.
[2] The term "small MS4" is defined at 40 CFR § 122.26(b)(16) to include, but is not limited to, separate storm sewers owned or operated by the United States, and located in a Census defined Urbanized Area, including "systems similar to separate storm sewer systems in municipalities, such as systems at military bases, large hospital or prison complexes, and highways and other thoroughfares but does not include storm sewers in very discrete areas, such as individual buildings." See also: 40 CFR §§ 122.30-37.

40 CFR § 122.34(c) requires water quality-based requirements for NPDES-regulated storm water discharges in addition to or that modify the SWMP control measures where needed to protect water quality or that are based on an EPA-approved water quality cleanup plan called a Total Maximum Daily Load (TMDL). Such water quality-based effluent limits are generally to be expressed in the form of BMPs; numeric limits in MS4 permits are used only in rare instances, and not in first iteration permits. (USEPA, 2016; USEPA, 2002; USEPA, 2014). EPA notes that no numeric limits are proposed for the permits under consideration. NPDES permits for small MS4 discharges must include terms and conditions to evaluate compliance with permit provisions, including achievement of measurable requirements established as permit requirements; see 40 CFR § 122.34(d).

Unlike NPDES requirements to obtain a permit for other types of discharge, operators of regulated small MS4 discharges are not required to submit complete MS4 outfall maps, nor to submit discharge characterization monitoring data as part of the permit application. The Permittee must complete and submit an accurate MS4 map during the initial permit term. Further, it is not mandatory that NPDES permits for MS4 discharges require discharge monitoring. Instead, 40 CFR §122.34(d) states "…*The NPDES permitting authority may determine monitoring requirements for the permittee in accordance with State/Tribal monitoring plans appropriate to the watershed*."

### 2.1.2 State of Idaho Requirements

Section 401 of the CWA, 33 U.S.C. § 1341, requires that a certification be obtained from the appropriate State or Tribal agency which certifies that the permitted discharge complies with the State's [or Tribe's] water quality standards as well as "other appropriate requirements of State/Tribal law." Under Section 401 of the CWA, 33 U.S.C. § 1341, States and Tribes may deny, grant or waive certification of permits or licenses. In addition, States and Tribes may include conditions in 401 certifications that ensure that state water quality standards are met. If these conditions are more stringent than the conditions in the permit, then the conditions must be included in the permit pursuant to CWA Section 401(d), 33 U.S.C. § 1341(d). IDEQ establishes water quality standards for waters of the State; EPA has included the conditions set forth in the IDEQ Section 401 certifications for each Permit.[3]

## 2.2 PROJECT DESCRIPTION

### 2.2.1 General Description of Stormwater Discharges

Stormwater is the surface runoff that results from rain and snow melt. Urban development alters the land's natural infiltration, and human activity generates a host of pollutants that can accumulate on paved surfaces. Contaminants become entrained in

[3] On July 13, 2020, USEPA updated its water quality certification regulations at 40 CFR Part 121. https://www.epa.gov/cwa-401/clean-water-act-section-401-certification-rule

stormwater from a variety of sources in the urban landscape, and discharge to surface waters. Urban stormwater is often a contributing factor to water quality impairments. Stormwater discharges typically contain a mixture of pollutants, including suspended solids (sediments); nutrients (nitrogen and phosphorus); chlorides; metals; petroleum hydrocarbons; bacteria; organic chemicals (pesticides, herbicides, and industrial); and surfactants (e.g. laundry detergents, industrial cleaners, and/or other soaps). These common pollutants are often present regardless of land use type within the drainage area. Other parameters such as pH, hardness, and conductivity are indicators used to measure the presence of pollutants that may negatively impact receiving waters. In addition, increased impervious surface area (such as, parking lots, driveways, and rooftops) interrupts the natural process of stormwater infiltration to vegetation and soils. The hydrologic effects of this alteration can include streambank scouring and downstream flooding, which can affect aquatic life and damage property. (NRC, 2008).

### 2.2.2 Description of the Regulated MS4 Discharges

As previously noted, MS4s are defined as any publicly owned conveyance or system of conveyance used for collecting and conveying storm water and that discharges to waters of the United States (40 CFR § 122.26(b)). Such systems may include roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains.

Regulated MS4s are those located in UAs as defined by the latest Decennial Census. (40 CFR § 122.32). The boundaries of the Lewiston, ID UA were established in the Year 2000 Census and were incrementally revised in the 2010 Census.

The Permits authorize City/LCSC and ITD2 MS4 discharges to the LGDP via the U.S. Army Corps of Engineers' (USACE) LLPs, Lindsay Creek, Tammany Creek, and the Snake River, subject to the implementation of comprehensive SWMPs and associated terms and conditions specified therein.

The City's MS4 serves approximately 9.7 square miles with an estimated 115,000 feet of storm sewer in place throughout the City. The LCSC MS4 is interconnected to the City's MS4 as described below. Surface drainage in much of the City is conveyed through privately-owned natural drainage ways. Most of the known City MS4 outfalls convey runoff to the USACE LLPs. Starting in 1972, the USACE built 7.6 miles of levees and their associated ponds along the Snake and Clearwater Rivers to protect the City from inundation by the rivers during construction of the Lower Granite Lock and Dam project. The dam backed up the Snake and Clearwater Rivers 39 miles east of the dam to the City to create the LGDP.[4] See also Section 2.3.1. The LLPs separate the river water from the City, but also physically separate much of the City's storm water runoff from directly discharging to the LGDP. A series of pumping stations, intakes and other structures were

[4] This BE document refers to the water behind the Lower Granite Lock and Dam as the LGDP (*Lower Granite Dam Pool*), using IDEQ's nomenclature for the relevant segment in Idaho. Several reference documents used to support this BE refer to this waterbody as the *Lower Granite Reservoir* and/or *the Clearwater River* as it flows towards its confluence with the Snake River to become part of the LGDP.

built so that water could be transferred from the ponds behind the levees to the LGDP when pond water levels dictate; water is also regularly pumped from the Snake River and LGDP into the levee ponds for irrigation and other purposes. Water pumped from the LLPs to the LGDP is a water transfer; water transfers are exempt from NPDES permitting. (40 C.F.R. § 122.3; see also 73 Federal Register [FR] 33697 (June 13, 2008).

The City describes their MS4 as three distinct areas (North Lewiston; Downtown/Normal Hill; and the Orchards), built on four distinct geomorphic features (USEPA, 2018a), namely: 1) low-lying flood plains along both sides of the Clearwater River, and along the Snake River, where the Downtown and North Lewiston areas are located; 2) ice-aged flood deposits forming the residential area known as Normal Hill; 3) a gently inclined basalt plateau forming the area known as the Orchards; and 4) a series of steep draws, gullies, ravines, breaklands, etc. around the edge of the Orchards plateau, where the landscape drops off sharply to the west towards Snake River; to the south, towards Tammany Creek, and to the west, towards Lindsay Creek (USEPA, 2018a).

The interconnected MS4s belonging to the City and LCSC drain stormwater runoff from the North Lewiston, Downtown/Normal Hill, and Orchards areas as follows:

- North Lewiston includes the Port District, Lewiston Hill, and Northeast Lewiston, and slopes toward the south; this area is served by a variety of MS4 structures that flow to the LLP North Levee infrastructure prior to discharge into the LGDP;
- The Downtown/Normal Hill area slopes to the north and the west and is drained by numerous MS4 conveyance structures of various sizes. LCSC is a public state college that occupies approximately 40 acres (~10 city blocks) in the Normal Hill area; the LCSC MS4 includes retention ponds, swales, sub-surface catch basins, collection reservoirs, and associated drainage lines that connect to the City's MS4. The City's MS4 draining from this area to the north/north west flows into the LLP West Levee infrastructure prior to discharge into the LGDP. This area includes the Southway, Bryden Canyon, and Country Club drainage areas, which slope steeply to the west, and discharge to the Snake River.
- The Orchards area includes a variety of MS4 structures, roadside ditches, and natural drainage ways. The southern portion of the Orchards plateau slopes to the south and east toward Tammany Creek; this area is drained predominately by roadside ditches. Three separate piped and open channel MS4s drain from the Orchards plateau to the north and converge to discharge into the LGDP through the LLP East Levee drainage tunnel called the "380 Structure." The eastern portion of the Orchards plateau, including East Lewiston, drains through the MS4 towards Lindsay Creek; Lindsay Creek then flows through its own drainage structure in the LLP East Levee to the LGDP.

Through a cooperative agreement between the City and ITD2, the City operates and maintains State of Idaho highway routes within City limits, which includes storm sewer and culvert maintenance for U.S. Highway 12 and its Frontage Road, U.S. 95 and State Highway 128 in the Downtown and North Lewiston areas. ITD2 conducts snow removal, culvert maintenance, and maintenance of unimproved roadsides on U.S. 95 and State Highway 128 only (USEPA, 2018a; USEPA, 2019a).

ITD2's MS4 in the Lewiston UA serves approximately 0.367 square miles along the state highway right of ways, and in general discharges directly via two outfalls to the LGDP. (USEPA, 2019a). ITD2's highway system in this area includes:

- *U.S. 12: Milepost 0 – 3.29*. Length of segment is 3.29 miles. Along U.S. Highway 12, beginning at the west city limits on Interstate Bridge via Snake River Ave., First Street, D Street Extension, east along the Dike Bypass to 18th/Main Street Intersection, continuing east along Main Street to 21st Street/G Street Intersection, then across the Memorial Bridge to the east end of the U.S. 12 – U.S. 95 Interchange.
- *U.S. 95: Milepost 310.75 – 312.50.* Length of segment is 1.75 miles. Along U.S. 95, beginning at the east city limits, through the U.S. 12 – U.S. 95 Interchange, including all ramps, to the base of Lewiston Hill.
- *State Highway 128:* Milepost 0 – 2.198. Length of segment is 2.198 miles. Along State Highway 128, beginning at the west city limits, continuing east to State Highway 128/U.S. 12 Intersection including all ramps. (USEPA, 2019a)

### 2.2.3 Permit Requirements

The Permits establish conditions, prohibitions, and management practices designed to reduce the discharge of pollutants from the MS4s to the MEP, to protect water quality, and to comply with appropriate CWA requirements. When finalized, the Permits require the Permittees to implement comprehensive SWMPs.

The fact sheets supporting each Permit include detailed explanations of the federal and state requirements, as well as specific water quality concerns. For that reason, this document provides only a summary of the provisions in the Permits. For details, please refer to the individual Permits and the accompanying fact sheets included as Appendix 2. In general, these provisions include implementation of specific tasks and practices; stormwater control design requirements; performance requirements; adaptive management requirements; schedules for implementation and maintenance; monitoring requirements based on existing water quality impairments identified by the IDEQ; and record keeping and reporting requirements.

EPA has defined the SWMP control measures and evaluation requirements that the Permittees must implement. These provisions are summarized in Table 2, below, and discussed in detail in Section 2.2.4.

| ***Table 2.1. Summary of Requirements in EPA's Permit Actions*** | |
|---|---|
| **Permit Part** | **Permit Provisions** |
| **2.1 through 2.4** | **Limitations on Permit Coverage**<br>• Discharges that cause or contribute to an excursion above the ID Water Quality Standards (WQS) are subject to notification and corrective action requirements in Permit Part 5;<br>• Discharge of snow and snow melt to surface waters, or to MS4, is prohibited, unless consistent with pollution prevention and operational practices specified in Permit Part 3.4;<br>• Discharges of otherwise regulated stormwater are allowed into the MS4, provided those discharges are authorized via alternative NPDES permit(s).<br>• Non-stormwater discharges from the MS4s are prohibited, except under specified conditions. |
| **2.5** | **Permittee Responsibilities:**<br>• The Permittee/MS4 Operator is responsible for permit compliance related to their MS4.<br>• The City and LCSC choose to share responsibilities as co-permittees.<br>• The City, LCSC and ITD2 may work with outside parties, to comply with one or more permit requirements.<br>• Each Permittee must maintain adequate legal authority- to the extent allowed under Idaho law- to implement the SWMP control measures in its jurisdiction.<br>• Each Permittee must maintain a written SWMP Document that summarizes how the Permittee implements the SWMP in its jurisdiction; collect and report summary information about its SWMP implementation activities; must provide adequate financial support to comply with the Permit; and must impose their SWMP in newly annexed areas within one year of annexation.<br>• Pursuant to IDEQ's certification, the Permittees must consider practices identified in the most recent version of the IDEQ's *Catalog of Stormwater Best Management Practices.* |
| **2.6** | **Alternative Control Measure Requests:**<br>A Permittee may, request EPA and IDEQ consider one or more Alternative Control Measures (ACMs) by submitting the documents, plans, or programs equivalent to a comparable Permit provision with supporting documentation. EPA and IDEQ will review whether the request is equivalent, and if so, EPA may modify the permit to reflect the ACM(s), pursuant to public notice and comment as required by 40 CFR §§ 122.62 and 124.<br>City/LCSC must submit a description of two Pollutant Reduction Activities and a Monitoring/Assessment plan that address impairment pollutants (*Sediment, E.coli, Nitrite plus Nitrate as nitrogen; Total Phosphorus*) in MS4 discharges to Lindsay and Tammany Creeks; as well as temperature in MS4 discharges to the Snake River. See Permit Part 4. |
| **3.1** | **Education, Outreach and Public Involvement:**<br>Each Permittee must conduct an Education, Outreach and Public Involvement Program, through activities targeted to specific audiences, and assessment of the intended results. The Permittees must also educate appropriate audiences regarding construction erosion control & permanent runoff control requirements in their jurisdiction. Permittees must maintain a publicly accessible website containing the Permittee's SWMP and all Annual Reports. |

***Table 2.1. Summary of Requirements in EPA's Permit Actions***

| Permit Part | Permit Provisions |
|---|---|
| **3.2** | **Illicit Discharge Detection and Elimination:**<br>Each Permittee must conduct an illicit discharge management program using methods to detect, identify sources, and remove identified non-stormwater discharges from the MS4. The purpose to eliminate unauthorized and illegal pollutant discharges into and from the MS4. This program must include:<br>• MS4 Map and Outfall Inventory;<br>• A regulatory mechanism such as ordinance to effectively prohibits most non-stormwater discharges into the MS4;<br>• A Complaint Reporting and Response Program;<br>• MS4 Outfall Screening during Dry Weather;<br>• Specific Follow-up Actions within certain timeframes;<br>• Spill Response and Prevention activities including notification requirements;<br>• Public Education on Proper Disposal of Used Oil and Toxic Materials; and<br>• Training for Responsible Permittee Staff. |
| **3.3** | **Construction Site Stormwater Runoff Control:**<br>The Permittee must use a regulatory mechanism, such as an ordinance, to:<br>• Require erosion controls, sediment controls, and materials management techniques to be employed and maintained at projects from initial clearing through final stabilization; for construction activities disturbing 1 or more acres of land.<br>• Review and approve preconstruction site plans to ensure appropriate controls are used at sites disturbing 1 acre or more.<br>• Conduct construction site inspections for sites disturbing 1 acre or more, prioritized by disturbance size & potential water quality impact;<br>Using available enforcement response, Permittees must enforce these requirements at sites disturbing 1 or more acres. Permittee must ensure responsible staff are sufficiently trained to conduct these tasks. |

***Table 2.1. Summary of Requirements in EPA's Permit Actions***

| Permit Part | Permit Provisions |
|---|---|
| **3.4** | **Post Construction Stormwater Management for New Development and Redevelopment**<br>The Permittee must use a regulatory mechanism, such as an ordinance**,** to:<br>• Require installation and long term maintenance of permanent stormwater controls at new development and redevelopment project sites, sufficient to retain onsite the runoff volume produced from a 24-hour, 95th percentile storm event, and/or provide a level of pollutant removal greater than the level of pollutant removal expected by the use of onsite retention of runoff volume produced from a 24 hour, 95th percentile storm event.<br>  o Permittees may submit a Treatment Equivalent expression of such requirements as an ACM, per Permit Part 2.6;<br>• Specify appropriate permanent controls for sites disturbing 1 acre of land or more;<br>• Review & approve preconstruction permanent control plans for sites disturbing 1 acre or more;<br>• Conduct prioritized inspections and enforce requirements for permanent stormwater controls to verify "as built" condition and ensure long term operation and maintenance (O&M); this includes use of O&M Agreements for controls on private property and tracking the condition of permanent controls in its jurisdiction; and<br>• Training for Responsible Staff. |
| **3.5** | **Pollution Prevention/Good Housekeeping for Municipal Operations:**<br>The Permittee must properly operate and maintain its MS4 and related facilities, using prudent good housekeeping and pollution prevention measures to protect water quality and reduce the discharge of pollutants through the MS4. To accomplish this, the Permit requires:<br>• Inspection and Cleaning of Catch Basins and Inlets;<br>• O&M Procedures for Streets, Roads, Highways and Parking Lots;<br>• Inventory and Management of Street/Road Maintenance Materials;<br>• Street/Road/Highway/Parking Lot Sweeping & Assessment of Existing Activities;<br>• O&M Procedures for Other Municipal Activities;<br>• Requirements for Pesticide, Herbicide, and Fertilizer Applications;<br>• Stormwater Pollution Prevention Plans for Permittee-owned Facilities;<br>• Litter Control; and<br>• Training for Responsible Staff. |

***Table 2.1. Summary of Requirements in EPA's Permit Actions***

| Permit Part | Permit Provisions |
|---|---|
| **4.0** | **Special Conditions for MS4 Discharges into Impaired Waters**<br>The City and LCSC MS4s discharge to Lindsay Creek and Tammany Creek, where IDEQ has established applicable Total Maximum Daily Load (TMDL) waste load allocations.<br>The City's MS4 discharges to a receiving water considered impaired by IDEQ but without an applicable TMDL (Snake River). Part 4 requires the City and LCSC to:<br>• Implement at least one (1) pollutant reduction activity designed to reduce *E. coli*, nitrogen, phosphorus, and sediment loadings from the MS4 into Tammany Creek.<br>• Implement at least one (1) pollutant reduction activity designed to reduce *E. coli*, nutrients, and sediment loadings from the MS4 into the South Fork Lindsay Creek.<br>• Submit a Monitoring/Assessment Plan that is designed to quantify, at a minimum, pollutant loadings from the MS4 into Lindsay Creek, and Tammany Creek, and assess temperature contribution from the MS4 into the Snake River. |
| **5.0** | **Required Response to Excursions of Idaho Water Quality Standards**<br>If the Permittee, EPA and/or IDEQ determine that the MS4 discharge causes or contributes to an excursion of Idaho WQS, the Permittee must notify EPA and IDEQ, and may be required to submit an adaptive management response report within 60 days thereafter to identify how the Permittee will mitigate or eliminate the MS4 discharge. Upon EPA/IDEQ approval, Permittee must immediately begin implementing the adaptive management practices and annually report on progress to date. EPA and IDEQ may modify the permit pursuant to NPDES regulation where additional permit conditions are warranted. |
| **6.0** | **Monitoring, Recordkeeping, and Reporting**<br>The Permittee must evaluate their Permit compliance at least annually, using the provided reporting format. Permittees conducting monitoring/assessment activities per the required Monitoring/Assessment Plan must submit their data. The Permittee must retain all related records for at least five years and submit such only when requested by EPA or IDEQ.<br>Annual Reports and SWMP Document must be available to the public via Permittee website. |
| **7.0 and 8.0** | **Standard NPDES Permit Conditions**<br>In addition to the standard conditions related to general compliance responsibilities pursuant to 40 CFR Part 122, Permit Part 8.1 contains a detailed list of documentation that each Permittee must submit with their Permit Renewal Application. |
| **Appx. A** | **Addresses and Contact Information** |
| **Appx. B** | **SWMP Document Template and Annual Report Form** |

### 2.2.4 SWMP Control Measure Effectiveness

Permittees are required to develop, implement, and maintain SWMPs that describe how the Permittees will manage stormwater and comply with the requirements of their Permit. The goals are to identify sources of pollution and to reduce or eliminate the introduction of pollutants to waterways via the MS4. The Permits allow for interim updates to the Permittee's program to further improve water quality or to address new information as it becomes available. The Permits require that the SWMPs be updated throughout the permit term to reflect any changes to how stormwater is managed.

Reducing pollutant loadings to receiving waters will improve aquatic habitats, water quality, and recreational uses of waterbodies. The Permits require that the Permittees implement procedures to achieve pollutant reductions to the maximum extent practicable through the implementation of control measures and associated BMPs. The Permittees must identify how they implement each component of the following control measures required by the Permits to reduce pollutants:

- Education and Outreach on Stormwater Impacts (Permit Part 3.1)
- Illicit Discharge Detection and Elimination (IDDE; Permit Part 3.2)
- Construction Site Runoff Control (Permit Part 3.3)
- Post-Construction Stormwater Management for New Development and Redevelopment (Permit Part 3.4)
- Pollution Prevention and Good Housekeeping for Operations and Maintenance (Permit Part 3.5)

Successful implementation of the control measures requires each Permittee to use both structural and non-structural BMPs. When properly designed, installed, and maintained, control measures and the associated BMPs improve stormwater quality (USEPA, 1999b; IDEQ 2020c).

The primary purpose of using BMPs is to protect beneficial uses of water resources by:

- Reducing pollutant loads and concentrations,
- Reducing discharges (volumetric flow rates) that cause stream channel erosion, and
- Reducing deviations from natural hydrology

Structural stormwater BMPs are items that are engineered, designed, and built to collect and treat stormwater runoff. This can be achieved by reducing flow rates, removing pollutants, or both. Structural BMPs include extended retention and detention basins, silt fences, gravity separators, rocky swales, vegetated buffers, etc. Additionally, structural BMPs that focus on restoring the natural hydrology of an area, otherwise known as green infrastructure BMPs, use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater by reducing the velocity of stormwater flow and encouraging filtration and infiltration into the ground. Examples of green infrastructure BMPs include rain gardens, tree boxes, pervious pavement, and infiltration measures.

Non-structural BMPs are often associated with source control methods, which focus on containing pollutants at the source rather than removing pollutants after they have been mobilized. Examples of non-structural BMPs include good housekeeping, landscape management practices, pet waste control, public education, covered outdoor storage, etc. (Urban Drainage and Flood Control District, 2010). Non-structural/operational BMPs are required to some extent as components of each control measure.

The following subsections describe each of the control measures required by the Permits and examples of structural and non-structural measures. Ultimately, the implementation of these control measures will help to eliminate or reduce stormwater pollutants and improve water quality, habitat, and recreational uses for the Action Area.

#### *2.2.4.a Education and Outreach on Stormwater Impacts*

Education and outreach programs target behavior changes by creating a community that is knowledgeable about stormwater impacts and controls. (USEPA, 2010). The Permits require that an Education and Outreach Program be designed to reduce or eliminate behaviors and practices that cause or contribute to negative stormwater impacts by targeting specific audiences.

Education and outreach programs include distribution of information, community events, websites, hotlines, and other outreach activities (USEPA, 2018b). Public outreach programs typically focus on identifying sources of pollutants that are related to residential activities and other non-point sources of pollution. Materials provided by the Permittees to their community audience should address topics such as:

- General Stormwater Awareness
- Lawn and Garden Care
- Pet Care
- Household Chemicals and Waste
- Proper methods for using water for dust control
- Proper design and use of green infrastructure
- Impacts of stormwater on threatened and endangered species

For example, the Permittees could educate the public as to why the over-application of fertilizer negatively impacts stormwater quality. By explaining that excess fertilizer is carried by stormwater into receiving waters, often contributing to negative impacts to aquatic life, the public may change their behavior. This behavior change should help to improve water quality and influence others to do the same. Education and Outreach meets the definition of a source control quantifiable method, as educating the public about stormwater pollutant sources will reduce the amount of pollutants discharged to the MS4 and receiving waters.

The Permits require that the Permittees assess the Education and Outreach for Stormwater Impacts activities for effectiveness and understanding of the topics. The assessment should answer the following:

- Which components of the program are the most effective?

- Which components are weak?
- How does the program affect people? How can Permittees target and solve problems by changing behavior? (Washington Department of Ecology, 2003)

Permittees are required to use the results from their assessment activities to direct future education and outreach in order to reduce pollutants.

### *2.2.4.b Illicit Discharge Detection and Elimination (IDDE)*

IDDE programs identify and eliminate or properly regulate discharges to the MS4 or receiving water. The Permits require that the Permittees implement an ongoing program to detect and correct illicit discharges within the MS4 permit area.

IDDE uses source control BMPs by providing proactive and reactive approaches to identify and eliminate illicit connections. When implemented properly, an IDDE program will reduce the introduction of pollutants of concern to waterways. For example, during wet weather screening, inspectors visit various stormwater outfalls during dry periods without a recent rain event. The inspectors evaluate if they see water or other pollutants discharging from the outfalls, indicating non-stormwater sources of pollutants. The inspectors then try to trace the pollutants upstream, to a specific source, ultimately detecting and eliminating the source of pollutants. (Brown et al, 2004)

Examples of techniques to identify and eliminate illicit connections include:

- Educating municipal staff and the public about illicit discharges
- Conducting Closed Circuit Television inspections of the MS4
- Dye testing and/or smoke testing
- Inspecting outfalls during dry weather/non-storm conditions
- Permanently plugging any identified illicit connections
- Connecting unpermitted discharges to sanitary system as appropriate

The Permits require that the IDDE program include field assessments to detect illicit discharges. Assessments must include monitoring of discharge locations for specific parameters that are only expected if a sanitary sewer cross connection and/or illegal dumping are present. Examples of such specific parameters include odd colors or odors, petroleum products, oils, surfactants, and tobacco. The mapping requirements found in Part 3.2.2 of the Permits are also an integral part of the MS4 program, allowing Permittees to know the location and track the condition of public stormwater assets. When different parameters are identified in MS4 discharges, Permittees can use various methods to trace and eliminate illicit connections. When illicit discharges are detected, the Permittees must address the identified problem with specific timeframes as outlined in each Permit.

Additionally, the development of systems to report discharges and spills provides a reactive source control approach to prevent pollution from entering waterways. This complements the Education and Outreach on Stormwater Impacts control measure, as the public can be a valuable resource for reporting these incidents. The Permits specifically prohibit unauthorized non-stormwater discharges.

All Permits identify specific notification and reporting requirements for illicit discharges including spills which are determined to constitute a threat to human health or the environment.

#### *2.2.4.c Construction Site Runoff Control*

Sites of land disturbance resulting from construction activities contribute to stormwater pollution and site operators must use BMPs to prevent pollutant discharges. Specifically, land disturbance and consequent vegetation removal expose sediment to stormwater. When it rains, stormwater carries sediments into local rivers and streams. This not only pollutes these waterways, but is known to damage aquatic and recreational resources, and affect aesthetic qualities. (USEPA, 2009). Sediment runoff rates from uncontrolled construction sites are typically 10 to 20 times greater than those from agricultural lands, and 1,000 to 2,000 times greater than sediment runoff rates from forest lands). Hence, an active construction site without proper controls can send more sediment to streams over a few weeks than might be deposited naturally over the course of many decades (USEPA, 1999b; USEPA, 2000a; USEPA 2000b).

The Permits require that the Permittees implement and enforce a program to require erosion and sediment controls from all land disturbances of one (1) acre or more within their jurisdictions (City or LCSC) or road rights-of-way (ITD2). Construction site runoff control specifications include:

- The use of an ordinance or other regulatory mechanism to require erosion control, sediment control, and waste materials management/pollution prevention practices at sites disturbing one or more acres.
- Site plan review prior to the start of construction to ensure appropriate practices are utilized.
- Specifications for long term operation and maintenance of construction site runoff control practices.

The majority of BMPs to be implemented at construction sites are designed to prevent or reduce total suspended solids (TSS) and provide flow control. Examples of these types of BMPs, and associated TSS reductions if available, include:

- Sediment basins – 60 -75% mean reduction in TSS (USEPA, 2005)
- Sediment traps
- Silt fences – 50 to 90% mean reduction in TSS, depending on filter fabric (USEPA, 1993: USEPA, 2005.)
- Construction sequencing – 42% reduction in TSS (Claytor, 1997)

- Seeding – 50 to 100% mean reduction in TSS (USEPA, 1993)
- Sod – 98 to 99% mean reduction in TSS (USEPA, 1993)
- Vegetated grass lined channels – 60 to 83% mean reduction in TSS (USEPA 1999a, USEPA, 2005)
- Mulching – 53 to 99.8% mean reduction in TSS, depending on mulch (Harding, 1990 and USEPA, 1993)
- Buffer strips – 90% mean reduction in TSS (Gillman, 1994)
- Swales – 67 to 99% mean reduction in TSS, depending on design (USEPA, 1999a)

Figure 2.1 summarizes the influent/effluent concentrations for TSS across a variety of BMPs.

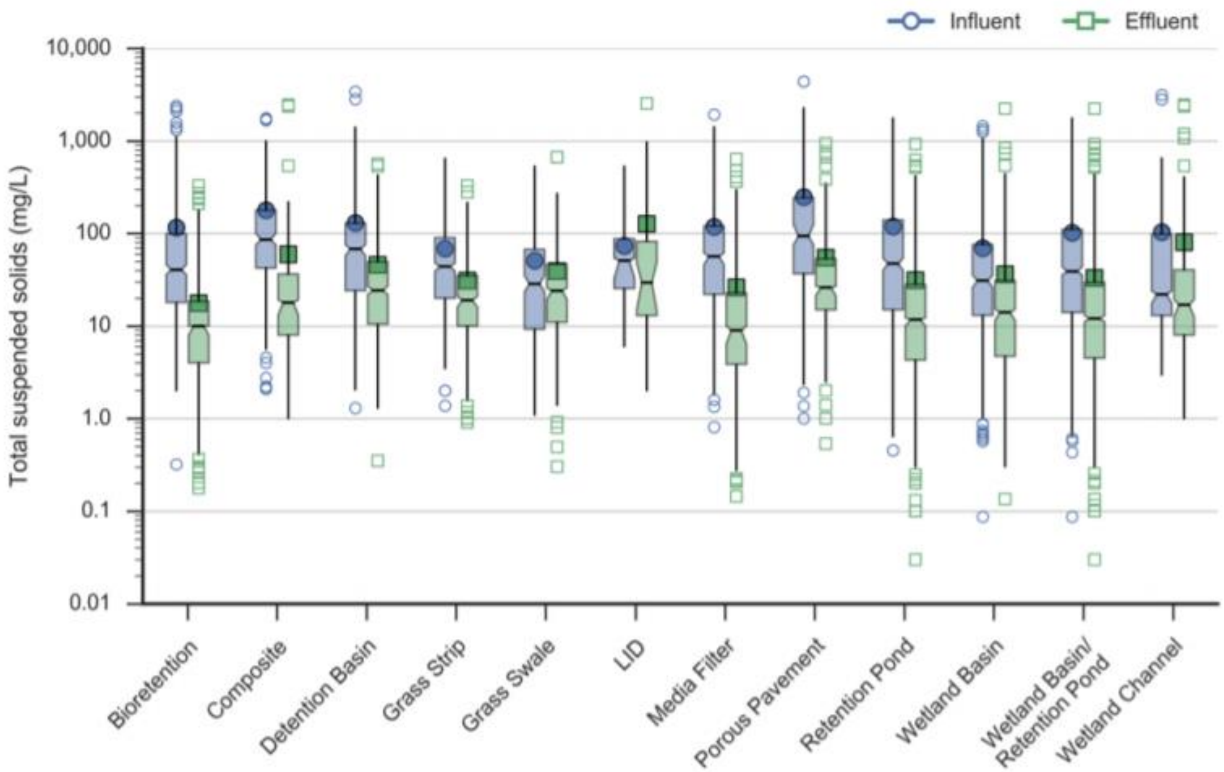


***Figure 2.1. Box plots of influent/effluent TSS concentrations for different BMPs (Geosyntec & Wright Water Engineers, 2017)***

### *2.2.4.d Post-Construction Stormwater Management for New Development and Redevelopment*

The Post-Construction Stormwater Management for New Development and Redevelopment program aims to reduce environmental harm and water quality degradation by implementing new development standards and inspection/enforcement protocols. New development projects and associated activities occur on undeveloped land, including open fields and vegetated areas. The focus of the new development aspect of the program is to maintain the current environmental baseline by ensuring that erosion and sediment control BMPs are installed, thereby mitigating the discharge of pollutants from construction activities to receiving waters. Additionally, the installation of structural BMPs and adherence to standards help to ensure that additional environmental harm is not caused by new development activities. On the other hand, redevelopment activities occur in areas that have been already been developed. This includes paved areas or impervious surfaces with existing land uses. The focus of the redevelopment aspect of the program is to improve the current environmental baseline.

The Permittees must develop and implement procedures to ensure that new development and/or redevelopment projects that disturb one (1) acre or more within their rights-of-way have installed and maintained sediment and erosion control BMPs that can retain onsite runoff volume produced from a 24-hour, 95$^{th}$ percentile storm event or are sufficient in providing the level of pollutant removal greater than the pollutant removal expected by using onsite retention for that specific storm event. Strategic use of nonstructural controls, in concert with site - appropriate structural BMPs, are recognized to effectively reduce sediment, nutrients and other pollutants that tend to bind to sediment particles, in MS4 discharges. The following are examples of the types of BMPs that will be imposed and that can suitably mitigate pollutants in MS4 discharges:

- **Site planning and site design principles** are considered source control practices that emphasize low impact development, use of vegetated buffers, and elimination of curb and gutter where feasible. These practices during the design phase of a project are particularly effective for preventing pollutants from entering receiving waters in the first place by reducing total flow volumes by avoiding discharge to the aquatic environment. At sites where it is feasible to do so, using practices that direct surface runoff into the ground via infiltration, vegetated swales, bioretention, and/or drywells can effectively control pollutants by preventing the discharge of excess runoff volumes and peak storm flows. (USEPA, 2005).

- **Vegetated filter strips** (VFS) are bands of dense vegetation through which stormwater runoff is directed, and are typically used to manage runoff from roads, highways, as well as from small parking or impervious areas. VFS are effective for stormwater treatment because they reduce the velocity of the stormwater flow and encourage infiltration, removing some sediment and other pollutants in the process. VFS are effective at reducing total suspended solids loading in stormwater runoff (see list above) and provide statically significant reductions of total/dissolved copper (69% and 56%), total/dissolved lead (77% and 71%), and total/dissolved zinc (66% and 59%) in runoff. (USEPA, 2005; IDEQ, 2020c; NASEM, 2014; Geosyntec & WWE, 2011c; Geosyntec & WWE, 2017).

- **Swales** often consist of natural or manmade shallow vegetated or rocky channels used to reduce flow rates, transport and infiltrate stormwater. Swales may be used as an alternative to curbs, gutters, and impervious stormwater conveyance structures. In most cases, swales have gentle sloping sides, with flow depths less than one foot. Grass swales are often used in long, narrow spaces, such as along roadway medians. In addition to reducing stormwater flow rates, grassy swales allow both infiltration and some treatment, allowing for solid particles to settle out, while plants in the swale act as a filter (Davis et al. 2012; Kazemi et al 2011; Xiao and McPherson, 2011; SVRP, 2015).Table 2.2, below, provides a summary of pollutant removal efficiency data for swales and channels.

***Table 2.2. Summary of pollutant removal efficiency data for grassed swales and channels (reported as a percentage; as cited in USEPA, 2009).***

| Study | Percent Removal | | | | | | |
|---|---|---|---|---|---|---|---|
| | **TSS** | **TP** | **TN** | **$NO_3$** | **Metals** | **Bacteria** | **Type** |
| Goldberg 1993 | 67.8 | 4.5 | -- | 31.4 | 42–62 | -100 | Grassed channel |
| Seattle Metro and Washington Department of Ecology 1992 | 60 | 45 | -- | -25 | 2–16 | -25 | Grassed channel |
| Seattle Metro and Washington Department of Ecology 1992 | 83 | 29 | -- | -25 | 46–73 | -25 | Grassed channel |
| Wang et al. 1981 | 80 | -- | -- | -- | 70–80 | -- | Dry swale |
| Dorman et al. 1989 | 98 | 18 | -- | 45 | 37–81 | -- | Dry swale |
| Harper 1988 | 87 | 83 | 84 | 80 | 88–90 | -- | Dry swale |
| Kercher, Landon, and Massarelli 1983 | 99 | 99 | 99 | 99 | 99 | -- | Dry swale |
| Harper 1988 | 81 | 17 | 40 | 52 | 37–69 | -- | Wet swale |
| Koon 1995 | 67 | 39 | -- | 9 | -35 to 6 | -- | Wet swale |
| Yousef et al. 1985 | -- | 8 | 13 | 11 | 14–29 | -- | Drainage channel |
| Yousef et al. 1985 | -- | -19.5 | 8 | 2 | 41–90 | -- | Drainage channel |
| Welborn and Veenhuis 1987 | 0 | -25 | -25 | -25 | 0 | -- | Drainage channel |
| Yu, Barnes, and Gerde 1993 | 68 | 60 | -- | -- | 74 | -- | Drainage channel |
| Dorman et al. 1989 | 65 | 41 | -- | 11 | 14–55 | -- | Drainage channel |
| Pitt and McLean 1986 | 0 | -- | 0 | -- | 0 | 0 | Drainage channel |
| Oakland 1983 | 33 | -25 | -- | -- | 20–58 | 0 | Drainage channel |
| Dorman et al. 1989 | -85 | 12 | -- | -100 | 14–88 | -- | Drainage channel |

- **Detention ponds, infiltration ponds, retention ponds, bioswales, and wetland basins,** installed where feasible and appropriate, are also known to be very effective at removing sediment and nutrients, and often work best in specific combinations or designs that target the pollutants of concern (Geosyntec & WWE, 2013; Geosyntec & WWE, 2017; USEPA, 2005). For bioretention and control measures using infiltration, the sedimentation and filtration of suspended solids in the top layers of the soil are extremely efficient. Several studies have shown that the upper layers of the soil captures metals, particulate nutrients, and carbon (NRC, 2008). See also, for example, EPA's rationale for onsite retention in USEPA 2018a, page 50.

### *2.2.4.e Pollution Prevention and Good Housekeeping for Operations and Maintenance*

Pollution prevention and good housekeeping for operations and maintenance (O&M) include the use of wide-ranging BMPs that focus on source control. Under the MS4 program, Permittees are required to evaluate their own housekeeping practices of municipal yards, station/base operations, streets, open spaces, and other areas that are owned and operated by the Permittees.

Specifically, the pollution prevention and good housekeeping component of the program focuses on controlling pollutant sources generated from Permittee-owned properties. Typical sources of stormwater pollution may include maintenance activities, chemical storage, waste and material storage, leaking equipment, and other uncontained sources of pollution. The Permits require that each municipal facility (maintenance yard, open space, etc.) develop and implement a site-specific Stormwater Pollution Prevention Plans (SWPPP) describing how stormwater pollutant sources and controls will be managed at the site.

The O&M component of the program focuses on improving stormwater quality through inspecting, cleaning, and maintaining Permittee-owned stormwater assets. Examples of these assets include catch basins, structural stormwater controls, and other stormwater structures used for flow control and treatment. Per the Permits, Permittees must oversee and perform activities to reduce stormwater pollution. The Permits require that the O&M program be designed to maintain and annually inspect Permittee-owned and/or operated permanent stormwater facilities used for flow control and treatment, other than catch basins. The Permits also state that the Permittees must conduct spot check inspections after major storm events and to provide adequate training for staff conducting maintenance and inspection activities.

The intent of the pollution prevention and good housekeeping and O&M program is to ensure that existing operations are performed in ways that will minimize contamination of stormwater discharges. Permittees must consider the following as part of their pollution prevention and good housekeeping:

- **Maintenance activities, maintenance schedules, and long-term inspection procedures.** Inspection and maintenance should be for both structural and non-structural controls, including the reduction of floatables and other items that could be discharged to the storm sewer system.
- **Controls for reducing or eliminating the discharge of pollutants** from Permittee-owned areas such as roads, parking lots, and maintenance yards. These controls can include recycling programs, pesticide, herbicide, and fertilizer reduction, and proper disposal of animal waste.
- **Procedures for the proper disposal** of waste removed from public areas, catch basins, roadways, and other public areas. (USEPA, 1999b, USEPA, 2005)

By conducting inspections of both municipal facilities (as a component of pollution prevention and good housekeeping requirements) and stormwater assets (as a component of O&M requirements), the Permittees will actively mitigate potential pollutant sources. For example, by assigning a stormwater team at municipal yards, individuals who are involved with the day-to-day operations at the facility may conduct daily inspections of areas known to generate pollutant sources. When conducting these inspections, they can ensure that potential sources of pollution are properly handled by covering or containing them so that they are not exposed to stormwater. By ensuring the control of these sources, various pollutants of concern will be prevented from contaminating stormwater that is discharged to receiving waters. Similarly, Permittees must ensure that structural stormwater controls are maintained and properly functioning to improve stormwater quality, reduce localized flooding, and improve public safety for the community.

The following are examples of applicable pollution prevention and good housekeeping BMPs, as well as source control/operational BMPs that the Permittees must implement in their jurisdictions:

- Pavement cleaning/street sweeping
- Litter control
- Proper waste disposal
- Proper material storage
- Staff training
- Vehicle/equipment cleaning and inspection
- Sweep all appropriate surfaces with sweepers regularly
- Construct impervious areas that are compatible with materials handled
- Use of spill control and prevention measures
- Inspect and regularly maintain stormwater facility assets

## 2.3 DESCRIPTION OF ACTION AREA

As described in Sections 1 and 2.2, EPA's Permit Actions under consultation are the proposed issuance of two MS4 NPDES Permits for the City/LCSC, and ITD2. These MS4s are located within or are adjacent to the Lewiston, Idaho UA, as defined by the 2000 Census and revised by the 2010 Census (please refer to the Fact Sheets). The City and LCSC MS4s discharge stormwater to the LGDP via the LLPs; the City's MS4 also discharges to Snake River, Tammany Creek, and Lindsay Creek; ITD2's MS4 discharges stormwater to the LGDP via the LLPs.

MS4 permitted discharges are not issued mixing zones, which are defined as a limited area or volume of water where initial dilution of a discharge takes place and where certain numeric water quality criteria may be exceeded. The pollutants discharged from the MS4s have varying degrees of transport and fate (persistence) within the water column, sediment, and the aquatic food web. Dilution of these pollutants depends on the hydrodynamics and assimilative capacity of the receiving waters. Some pollutants are sequestered or mineralized close to the point of discharge, while others may bioaccumulate or biomagnify in the aquatic food web. Therefore, some species may be exposed via surface water pathway to the pollutants discharged in the vicinity of the outfalls while others may be exposed through the food web pathway at some unknown distance.

The definition of the Action Area is *all areas to be affected directly and indirectly by the proposed action and not merely the immediate area involved in the action* (50 CFR § 402.02). To provide a reasonable focus for this consultation, the Action Area was delineated by the upstream MS4 discharge points downstream to a boundary where the measurable effects of the action are reasonably certain to occur.

Since the proposed action is the issuance of NPDES permits, toxicity or other impacts to a listed species may occur from exposure to individual and combined pollutant concentrations within the hydrodynamic mixing zone. The area where exposure may occur begins at the point of discharge. A portion of the stormwater runoff from the City/LCSC is collected in the LLPs, which is then pumped into the LGDP, while the remaining stormwater runoff is discharged directly to receiving waters via MS4 outfalls. Therefore, the Action Area is bounded on the upper end by conveyances and outfalls that discharge directly to the LGDP at the LLPs Pond B Pump Station and the Snake River – Country Club outfall on the Snake River. Stormwater discharge locations continue downstream from these upper boundaries in both rivers to the confluence of the LGDP and Snake Rivers (Figure 2.2).

Indirect effects of the proposed action are those that would cause an effect to a listed species or habitat from individual and/or combined pollutant concentrations within the waterbody at a later time (i.e., effects not causing immediate toxicity). These effects would result from delayed exposure (e.g., uptake of deposited effluent constituents from sediment resuspension, consumption of prey species, and habitat modification [e.g., deposited effluent constituents on the riverbed, decrease in photosynthesis]). Any of these indirect effects could occur as long as there is influence from that parameter on the water column and sediment quality

In the absence of empirical sediment and/or tissue data, EPA is not able to reliably detect, measure, and relate a far-field indirect effect to ESA-listed species and their prey that may be a result of bioaccumulated stormwater pollutants discharged from the MS4 areas. Therefore, EPA used CORMIX modeling along with the interim Reasonable and Prudent Alternative (RPA) for mercury to estimate the downstream boundary of the Action Area (Appendix 1).

EPA made several conservative assumptions when establishing the model inputs, such as modeling all stormwater discharges as one continuous discharge from a single outfall location; using the largest pipe diameter resulting in less nearfield dilution; a 7Q10 ambient flow rate; and a stormwater pollutant baseline of 0.0 µg/L (i.e. the ambient levels of the pollutant). Based on these assumptions, EPA determined that the downstream extent of the Action Area was 188m from the LLP West Levee Pond discharge location into the confluence of the Snake and LGDP (Appendix 1). Stormwater, through surface runoff, discharge to Lindsay Creek, and Tammany Creek, and therefore these receiving waterbodies area also part of the Action Area.

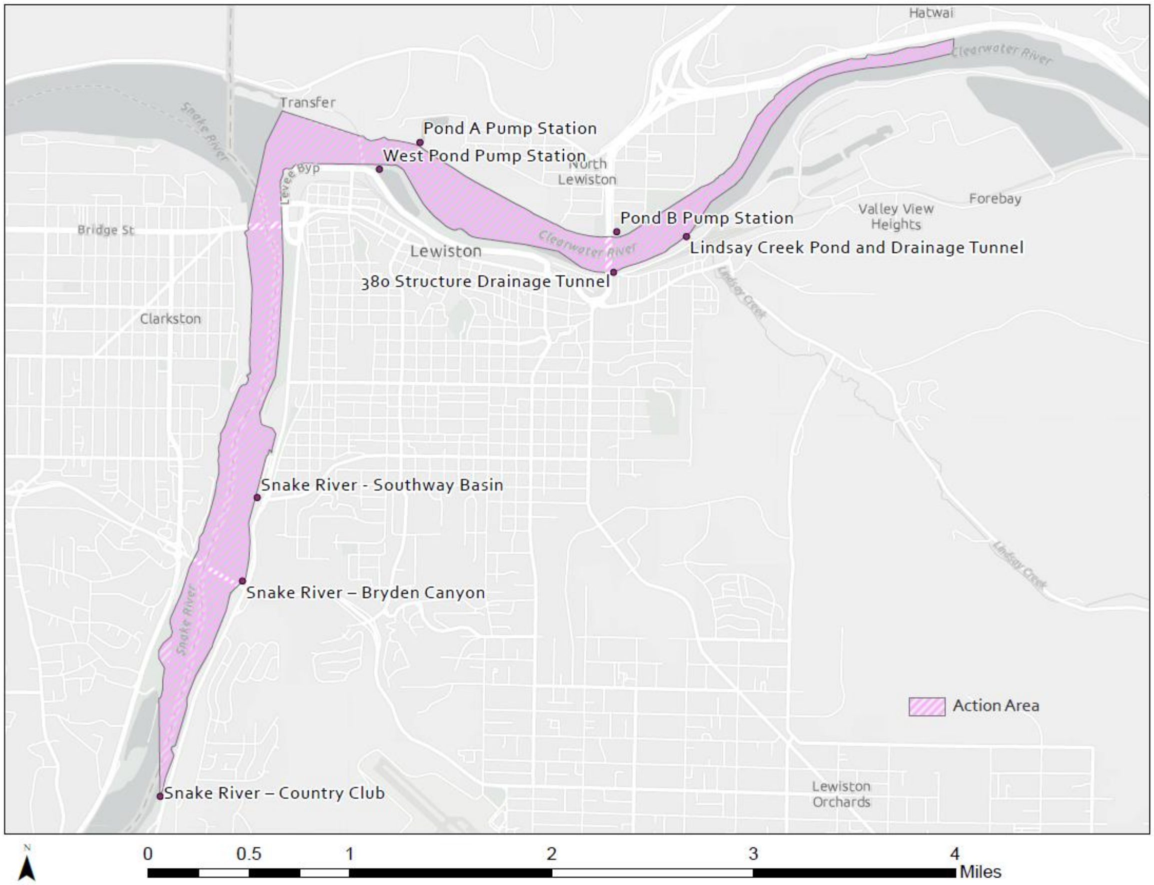


***Figure 2.2. Receiving water and Action Area overview map.***

### 2.3.1 Hydrology

The Lewiston UA is located in the Lower Snake-Asotin Subbasin, HUC 170601, and the Clearwater Subbasin, HUC 170603. Lindsay Creek is a tributary of the LGDP, and Tammany Creek is a tributary to the Snake River.

Upstream of the stormwater discharges from the City of Lewiston, both the North Fork of the Clearwater and the Snake Rivers are regulated by dams. Dworshak Dam (completed in 1957), which is located on the North Fork of the Clearwater River, has a large impact on flow and temperature in the LGDP. The Hell's Canyon Complex is upstream of the Action Area on the Snake River. Four dams impound the lower Snake River downstream of the discharge, including Ice Harbor (completed 1961), Lower Monumental (completed 1969), Little Goose (completed 1970), and Lower Granite (completed 1975). Of these dams, the Lower Granite Dam, which is 39 miles downstream, is the closest to the Action

Area. As noted in Section 2.2.2, the LGDP is impounded behind the Lower Granite Dam. (USEPA, 2003a).

The LGDP is 39 miles in length, has a mean depth of 54 ft. and a mean width of 2,100 ft. (Bennett et al. 1993 as cited in USEPA, 2003a), and exhibits a typical longitudinal impoundment gradient composed of three reach types. The uppermost portion of the LGDP is the most riverine. This reach includes the confluence of the Clearwater and Snake Rivers, which is an important fish habitat area due to greater water velocity and cooler water inflow from the Clearwater. A mid-reservoir reach represents the largest section the reservoir and is transitional from lotic to more lentic conditions nearer the dam. The reach immediately above the dam is the forebay and has entirely lentic characteristics (Zimmerman and Parker, 1995 as cited in USEPA, 2003a).

To compensate for increased water levels resulting from the LGDP, the USACE built the levee system known as the LLPs to contain the Snake and Clearwater Rivers. The USACE manages four ponds located in Lewiston on the land side of the levees. As part of the management of these four ponds, water is pumped from the ponds to the rivers to discharge excess water runoff from Lewiston and seepage from the levees back into the rivers (Steevens et al., 2005b).

Prior to the construction of the four dams, the lower Snake River had an alluvial morphology consisting of a longitudinal profile of pool-riffle-run sequences. Water levels fluctuated by as much as 20-30 ft. The impoundment of the river converted the lower Snake River to a continuous reservoir system. The only areas that retain riverine characteristics are the relatively short and discontinuous tailrace areas just downstream of each dam.

The lower Snake River has a mean annual discharge of 49,800 cfs with mean peak discharge of 169,257 cfs (1957-1998). The Clearwater River is the Snake’s largest tributary, historically contributing approximately 39 percent of the flow to the Snake River. During summer low flow periods, the Clearwater contributes about 50 percent of the Snake’s flow due to releases from the Dworshak Dam (USEPA 2003a).

### 2.3.2 Physical environment

The Action Area straddles the major physiographic region of the Pacific Northwest known as the Snake River Plateau, and the southern portion of the Columbia Plateau. Lava flows from the Columbia River Basalt Group comprise the geologic foundation in the plateau regions. Deep, clay-rich, fertile soils formed from wind-blown silt (loess) and volcanic ash mantle these basalt landscapes. Soil characteristics, coupled with local land use and climatic patterns, make rill and sheet erosion a substantial issue throughout much of the Action Area. The topography of the lower Snake River basin ranges from areas of broad valleys with gentle slopes to areas of deep confined canyons with steep walls (NPCC, 2004).

### 2.3.3 Climate

The climate in the Action Area is semi-arid with precipitation mostly in the winter and spring and is more arid than in the Snake River's upstream drainage areas (NPCC 2004). Annual precipitation along the Snake River averages 13 to 18 inches. In the river canyons, strong winds are common, generally blowing in a westerly direction. Yearly average wind speeds range from four to six miles per hour. The summers are hot, with temperatures often in the 90s and occasionally over 100 °F (32-38 °C). It is not uncommon to have periods of a month or more in the summer without precipitation Although annual precipitation is low, the low elevation results in susceptibility of much of the area to flashy flows resulting from rain or snow events. Timing of annual peak flows in the lower Snake River basin ranges from early December through late May (NPCC, 2004).

### 2.3.4 Demographics and Land Use

The total population residing in the Action Area is approximately 32,820 people; the population growth rate in the City of Lewiston between Years 2010 through 2020 was approximately 2.9% (Lewiston, 2016, updated 2020).

Land use within the City limits is predominately suburban residential (56.89%, or 6,205 acres); the City's commercial and industrial land uses comprise approximately 10.06% (1,096 acres) and 11.04 (1,203 acres) of the total land area, respectively. Agricultural/transitional land use within the City is estimated at approximately 13.76% (1,501 acres); and the Nez Perce County Airport represents the remaining 7.70%, or 840 acres, within the City. (Lewiston, 2016). See also Section 5.2.1

### 2.3.5 Designated Uses and Impairments

Section 303(d) of the Clean Water Act, 33 U.S.C. § 1313(c), requires every State to develop water quality standards applicable to all waterbodies or segments of water bodies that lie within the State. A water quality standard defines the water quality goals of a water body, or a portion thereof, by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by establishing anti-degradation policies and implementation procedures that serve to maintain and protect water quality. States adopt water quality standards to protect public health or welfare, enhance the quality of water, and serve the purposes of the Clean Water Act. A water quality standard should (1) include provisions for restoring and maintaining chemical, physical, and biological integrity of State waters; (2) provide, wherever attainable, water quality for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water; and (3) consider the use and value of State waters for public water supplies, propagation of fish and wildlife, recreation, agriculture and industrial purposes, and navigation.

Water quality criteria set ambient levels of individual pollutants or parameters or describe conditions of a waterbody that, if met, will generally protect the designated use of the water. Water quality criteria are developed to protect aquatic life and human health, and, in some cases, wildlife, from the deleterious effects of pollutants. Water quality criteria consist of three components: magnitude (the level of pollutant that is allowable, generally expressed as a concentration); duration (the period of time over which the instream concentration is averaged for comparison with criteria concentrations); and frequency (how often criteria can be exceeded).

Narrative criteria are statements that describe the desired water quality goal and supplement the numeric criteria. Narrative criteria can be the basis for limiting specific pollutants where the State has no numeric criteria for those pollutants, or they can be used to limit toxicity where the toxicity cannot be traced to a specific pollutant (e.g., whole effluent toxicity).

40 CFR § 131.12 requires States to adopt an anti-degradation policy and implementation methods that provide three tiers of protection from degradation of water quality. Tier 1 protects existing uses and provides the absolute floor of water quality for all waters of the United States. Tier 2 protects the level of water quality necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water in waters that are currently of higher quality than required to support these uses. Tier 3 protects the quality of outstanding national resources, such as waters of national and State parks and wildlife refuges, and waters of exceptional recreational or ecological significance. The State of Idaho has an antidegradation policy as well as antidegradation implementation procedures. As defined by the State of Idaho, Lindsay Creek, Tammany Creek, the Snake River and the LGDP are protected as Tier 1 from degradation of water quality; the Snake River and the LGDP are also protected as Tier II for contact recreational use; the LGDP is also protected for aquatic life use. (IDEQ, 2020a; IDEQ 2020b)

As described above, storm water from the Lewiston area discharges to the LGDP, the Snake River, Lindsay Creek, and Tammany Creek. IDEQ has classified all of these water bodies as fresh water with the following designated uses: wildlife habitat; industrial water supply; and agricultural water supply. The Snake River, from the Asotin River to LGDP, is also designated for domestic water supply, maintenance and protection of cold water aquatic life, and primary contact recreation. The LGDP is designated for domestic water supply, maintenance and protection of cold water aquatic life, and primary contact recreation. Lindsay Creek, source to mouth, is designated for maintenance and protection of cold water aquatic life, and secondary contact recreation for wading, boating, swimming, and other uses.

Any water body that does not and/or is not expected to meet the applicable water quality standards is described as “impaired”. Section 303 (d) of the CWA, 33 U.S.C. §1313(d) requires States to develop TMDL plans for water bodies designated as impaired. The State of Idaho’s 2016 Integrated Report lists the following water bodies in the Lewiston UA as water quality-impaired (i.e., does not meet water quality standards): the Snake River is impaired for temperature; Lindsay Creek and Tammany Creek are impaired for bacteria, nutrients, and sediment, respectively. As summarized below in Table 2.1, IDEQ has developed TMDLs for both Tammany and Lindsay Creek, and is currently working on a TMDL to address temperature impacts to the Snake River. (IDEQ, 2020a; IDEQ 2020b).

***Table 2.3. Impaired waters and TMDLs within the Lewiston UA.***

| Receiving Water | IDEQ Waterbody Assessment Unit | Impairment Pollutants | TMDL Status |
|---|---|---|---|
| **LGDP** | ID17060306CL001_07 *Lower Granite Dam Pool* | None - Fully Supporting beneficial uses. | Not applicable. |
| **Lindsay Creek** | ID17060306CL003_02 Lindsay Creek - *Source to mouth*<br>ID17060306CL003_03 Lindsay Creek - *Source to mouth* | *E.* coli<br>Nutrient/Eutrophication Biological Indicators<br>Sedimentation/Siltation | *Lindsay Creek Watershed Assessment and Total Maximum Daily Loads,*<br>December 2006, Amended March 2007.<br>Approved, June 2007. |
| **Tammany Creek** | ID17060103SL014_02 *WBID 015 to unnamed trib.*<br>ID17060103SL014_03 *Unnamed Trib. to mouth*<br>ID17060103SL016_02 *Source to Unnamed Trib.* | *E. coli*<br>Nitrogen, Nitrate.<br>Total Phosphorus<br>Sedimentation/Siltation | *Tammany Creek Watershed (HUC 17060103) TMDL Addendum;* September 2010.<br>Approved, December 2010. |
| **Snake River** | ID17060103SL001_0*8 Snake River - Asotin River (Idaho/Oregon border) to LGDP* | Temperature | No TMDL completed. |

## 2.3.6 Current and Past Projects in the Action Area

The environmental baseline is discussed further in Section 4. The status of listed species within the Action Area suggests that essential biological requirements of these species are generally not being met, as indicated by the small population size of wild fish and the 10-year average return of hatchery fish (NMFS 2004). Activities occurring in or near the Action Area which may impact receiving water quality and interact with the permitted discharges addressed in this BE include:

- Air deposition from the Clearwater Paper Corporation-Lewiston Mill stacks
- Recreational boating (contributes hydrocarbons)
- Agricultural practices, including irrigation and irrigation returns (contributes to flow alteration and increased pesticides, herbicides, nutrients, sedimentation and temperature)
- Grazing (contributes nutrients, sedimentation, bacteria and increased temperature)
- Timber harvesting (contributes sedimentation and increased temperature)

- Dam operations (contributes to increased temperature, flow alteration, and increased dissolved gas). Dam operations have had a major influence on the quantity and quality of salmonid habitat available in the Action Area (PNNL 2002). Upstream of the Action Area, both the North Fork of the Clearwater and the Snake Rivers are regulated by dams. The Dworshak Dam on the North Fork of the Clearwater River greatly influences the flow and temperature of the Clearwater River. In the Snake River, there are several Idaho Power dams upstream of the Action Area in Hells Canyon Complex.
- Clearwater Paper Corporation-Lewiston Mill water rights (contributes to flow alteration)
- Clearwater Paper Corporation-Lewiston Mill effluent discharge
- Urban development (contributes to increased sedimentation, hydrocarbons and temperature)
- Sand and gravel operations (contributes to increased sedimentation and temperature)
- Fish hatcheries (contributes to introduction of nonnative fishes and increased nutrients)
- Aquatic pesticide use
- Operation and maintenance of the LLPs by the USACE
- Discharges from Publicly Owned Treatment Works (POTWs)

# 3. STATUS OF SPECIES AND CRITICAL HABITAT

## 3.1 SPECIES LISTS FROM THE SERVICES

This Section describes the species that may occur within the Action Area which are federally listed as threatened and endangered (T&E). Table 3.1 describes the potentially affected T&E species, based on communication with NMFS (NMFS, 2020), as well as those species identified by the USFWS' Information for Planning and Consultation website (USFWS, 2020). Table 3.2 describes designated critical habitats within the Action Area.

This Section will examine the potential affects to species and their critical habitat, where applicable, by detailing the species' biological requirements, factors of decline, local empirical information and population trends, and the presence of species in relation to the Action Area.

***Table 3.1. ESA Listed Species Present Within the Action Area***

| Species | Population | Present Status | Federal Register Notice | |
|---|---|---|---|---|
| Chinook salmon (*Oncorhynchus tshawytscha*) | Snake River Spring/Summer and Fall Evolutionarily Significant Unit (ESU) | Threatened | 70 FR 37160 | 6/28/2005 |
| Chinook salmon (*O. tshawytscha*) | Snake River Fall ESU[1] | Threatened | 70 FR 37160 | 6/28/2005 |
| Sockeye salmon *(O,.nerka*) | Snake River ESU | Endangered | 70 FR 37160 | 6/28/2005 |
| Steelhead *(O. mykiss*) | Snake River ESU | Threatened | 71 FR 834 | 1/5/2006 |
| Bull trout *(Salvelinus confluentus)* | Columbia River Distinct Population Segment (DPS) | Threatened | 64 FR 58909 | 11/1/1999 |
| Spalding's catchfly *(Silene spaldingii)* | West-central Idaho | Threatened | 66 FR 51598 | 10/10/2001 |

***Table 3.2. Summary of critical habitat designations for ESA-listed species listed under the ESA within the Action Area***

| **Species** | **Population** | **Present Designation** | **Federal Register Notice** | |
|---|---|---|---|---|
| Chinook salmon (*Oncorhynchus tshawytscha*) | Snake River Spring/Summer and Fall ESU | Final Rule | 64 FR 57339 | 10/25/1999 |
| Chinook salmon (*O. tshawytscha*) | Snake River Fall ESU | Final Rule | 64 FR 57339 | 10/25/1999 |
| Sockeye salmon *(O. nerka*) | Snake River ESU | Final Rule | 58 FR 68543 | 12/28/1993 |
| Steelhead *(O. mykiss*) | Snake River ESU | Final Rule | 70 FR 52630 | 9/2/2005 |
| Bull trout *(Salvelinus confluentus)* | Columbia River DPS | Final Rule | 70 FR 56212 | 9/26/2005 |

## 3.2 FISH

The following sections describe each of the ESA-listed salmonid species (fall Chinook salmon, and spring/summer Chinook salmon (*O. tshawytscha*), Snake River sockeye salmon (*O. nerka*), Snake River steelhead trout (*O. mykiss*), and bull trout (*Salvelinus confluentus*) relevant to this action (see Table 3.1). A discussion of the life history, habitat use, and habitat concerns, as well as specific information on occurrence in and use of the Action Area is presented for each species. Table 3.3 summarizes the potential for individual species to be present within the Action Area during specific times of the year and life stages (gray represents presence).

***Table 3.3. Generalized life history periods and potential presence within the Action Area (adopted from USEPA, 2003).***

| Species | Life History Phase | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bull Trout** | Adult movement | | | | | | | | | | | | |
| | Juvenile movement | | | | | | | | | | | | |
| **Fall Chinook (ocean and reservoir type juveniles)** | Adult migration | | | | | | | | | | | | |
| | Spawning/incubation | | | | | | | | | | | | |
| | Smolt outmigration | | | | | | | | | | | | |
| **Sockeye (yearling)** | Adult migration | | | | | | | | | | | | |
| | Smolt outmigration | | | | | | | | | | | | |
| **Spring/Summer Chinook (yearlings)** | Adult migration | | | | | | | | | | | | |
| | Smolt outmigration | | | | | | | | | | | | |
| **Steelhead (1-3yr old)** | Adult overwintering | | | | | | | | | | | | |
| | Adult migration | | | | | | | | | | | | |
| | Pre-smolt rearing | | | | | | | | | | | | |
| | Smolt outmigration | | | | | | | | | | | | |

*Timing of presence of salmon/steelhead species in the Action Area by life history phase based on passage data collected at the Lower Granite Dam (Columbia River Data Access in Real Time database [DART]). Bull trout presence data are very limited, and timing is therefore estimated (USACE, 1999, as cited within USEPA, 2003a).*

Additionally, the designated critical habitats for these five species are described in NMFS' *Endangered Species Act Biological Opinion on the Environmental Protection Agency's Proposed Approval of Certain Oregon Water Quality Standards Including Temperature and Intergravel Dissolved Oxyge*n (NMFS 2015):

> "*Interior Columbia [IC] Recovery Domain.* Critical habitat has been designated in the IC recovery domain, which includes the Snake River (SR) Basin, for SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, …[and]…SR sockeye salmon….
>
> "Habitat quality in tributary streams in the IC recovery domain varies from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994; NMFS, 2009 [as cited in NMFS 2015]). Critical habitat throughout much of the IC recovery domain has been degraded by intense agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems for critical habitat in developed areas.
>
> "Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System in the mainstem Columbia River, Bureau of Reclamation tributary projects, and privately-owned dams in the Snake and Upper Columbia river basins…"

The analysis of critical habitat is based on the biological requirements of the Action Area related to listed species are those physical or biological features (PBFs) that are essential to conservation of the species. NMFS-USFWS regulations state that federal agencies must consider those physical and biological features that are essential to the conservation of a given species (71 FR 69060 [November 29, 2006]). These features of Critical Habitat are called "primary constituent elements" (PCEs) that are essential to support one or more of the life stages of salmon and steelhead. The Services have decided to rename PCEs to PBFs. The PCEs will be referred to as PBFs in this BE. The PBFs for the four salmon species assessed in this BE (specifically, SR Fall Chinook, SR Spring/Summer Chinook, SR Steelhead, and SR Sockeye) are compiled in Table 3.4. These species have some level of geographic overlap and have similar life history characteristics and, therefore, require many of the same habitat functions provided by critical habitat. The PBFs for bull trout are presented in the bull trout Critical Habitat description (Section 3.2.6.e).

***Table 3.4. Salmonid PBFs (formerly PCEs) for critical habitat and corresponding species life history events. (NMFS, 2015).***

| Site | Site Attribute | Species Life History Event |
|---|---|---|
| Spawning and juvenile rearing areas | Access (sockeye)<br>Cover/shelter<br>Food (juvenile rearing)<br>Riparian vegetation<br>Space (Chinook)<br>Spawning gravel<br>Water quality<br>Water temperature (sockeye)<br>Water quantity | Adult spawning<br>Embryo incubation<br>Alevin development<br>Fry emergence<br>Fry/parr growth and development<br>Fry/parr smoltification<br>Smolt growth and development |
| Juvenile migration corridors | Cover/shelter<br>Food<br>Riparian vegetation<br>Safe passage<br>Space<br>Substrate<br>Water quality<br>Water quantity<br>Water temperature<br>Water velocity | Fry/parr seaward migration<br>Smolt growth and development<br>Smolt seaward migration |
| Adult migration corridors | Cover/shelter<br>Riparian vegetation<br>Safe passage<br>Space)<br>Substrate<br>Water quality<br>Water quantity<br>Water temperature<br>Water velocity | Adult sexual maturation<br>Adult "reverse smoltification"<br>Adult upstream migration<br>Kelt (steelhead) seaward migration |
| **Physical and Biological Features for Steelhead** | | |
| Freshwater spawning | Spawning gravel /substrate<br>Water quality<br>Water quantity | Adult spawning<br>Embryo incubation<br>Alevin development |
| Freshwater rearing | Flood plain connectivity<br>Forage<br>Natural cover<br>Water quality<br>Water quantity | Fry emergence<br>Fry/parr growth and development |
| Freshwater migration | Free of artificial obstructions<br>Natural cover<br>Water quality<br>Water quantity | Adult sexual maturation<br>Adult upstream migration<br>Kelt (steelhead) seaward migration<br>Fry/parr seaward migration |

### 3.2.1 Overview of Chinook Salmon

Chinook salmon, also called king salmon, are the largest and least abundant species of Pacific salmon (NMFS, 2005a). Chinook salmon are anadromous and semelparous, meaning adults migrate from a marine environment into their natal freshwater streams (anadromous) where they spawn and die (semelparous). Adult female Chinook will prepare a spawning bed, called a redd, in a stream area with suitable gravel composition, water depth, and velocity. Redds will vary widely in size and in location within the stream or river. After laying eggs in a redd, adults will guard the redd from 4 to 25 days before dying. Eggs hatch, depending upon water temperatures, between 90 to 150 days after deposition. Stream flow, gravel quality, and silt load all significantly influence the survival of developing Chinook salmon eggs. Juvenile Chinook may spend from 3 months to 2 years in freshwater after emergence and before migrating to estuarine areas as smolts, and then into the ocean to feed and mature.

Adults spend one to six years in the ocean before migrating back to natal freshwater streams to spawn and subsequently die. Compared to other Pacific salmon species, Chinook prefer larger and deeper stream habitat (NMFS, 2005). Juveniles feed on terrestrial and aquatic invertebrates, while subadults (i.e., post-smolt stage) and adults consume larger prey. The distribution of Chinook salmon in the marine environment is not well characterized; however, they may be found as far north as Alaska, as far south as California, and as far west as Russia and Japan (NMFS, 2016a). The following is a summary of chinook life history types (NMFS, 1998).

"Among Chinook salmon two distinct races have evolved. One race, described as a "stream-type" Chinook, is found most commonly in headwater streams. Steam-type Chinook salmon have a longer freshwater residency and perform extensive offshore migrations before returning to their natal streams in the spring or summer months. The second race is called the "ocean-type" Chinook, which is commonly found in coastal streams in North America. Ocean-type Chinook typically migrate to sea within the first 3 months of emergence, but they may spend up to a year in freshwater before emigrating. They also spend their ocean life in coastal waters. Ocean-type Chinook salmon return to their natal streams or rivers in spring, winter, fall, summer, and late-fall runs, but summer and fall runs predominate. both genetic and morphological differences are found between these life history types.

"Juvenile stream- and ocean-type Chinook salmon have adapted to different ecological niches. Ocean-type Chinook salmon tend to use estuaries and coastal areas more extensively for juvenile rearing. Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, which are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of sub-yearling smolts. At the time of saltwater entry, stream-type (yearling) smolts are much larger than their ocean-type (sub-yearling) counterparts and are, therefore, able to move offshore relatively quickly…

"Early researchers recorded the existence of different temporal "runs" or modes in the migration of Chinook salmon from the ocean to freshwater. Freshwater entry and spawning timing are believed to be related to local temperature and water flow regimes. Seasonal "runs" (i.e., spring, summer, fall, or winter) have been identified based on when adult Chinook salmon enter freshwater to begin their spawning migration. However, distinct runs also differ in the degree of maturation at the time of river entry, the thermal regime and flow characteristics of their spawning site, and their actual time of spawning. Egg deposition must occur at a time that will ensure that fry emerge during the following spring when the river or estuary productivity is adequate for juvenile survival and growth. The Columbia River supports the freshwater phase of substantial Chinook populations. (NMFS, 1998)

Chinook salmon runs of the Snake River basin are separated into two ESUs: fall-run and spring/summer run, based on genetic distinction (Waples et al. 1991). Also, the spring/summer run and fall run subpopulations are distinguished from one another by the seasons during which they return to freshwater streams. The characteristics of two ESUs are discussed separately in the following sections. Note, these ESUs may include both naturally spawned and artificially propagated (hatchery stock) fish.

### 3.2.2 Snake River Fall-Run Chinook Salmon (Threatened)

The Snake River fall Chinook salmon ESU was listed as threatened on April 22, 1992 (57 FR 14653), and the threatened status was reaffirmed in 2005 (70 FR 37160). In 2016, NMFS conducted a 5-year review of the status of the species and announced a 12-month finding on a petition to delist the species. Based on the best available scientific information, NMFS determined that the "threatened" classification remained appropriate (NMFS, 2016a; also 81 FR 33469).

Critical Habitat was designated for this run on December 28, 1993 (58 FR 68543). Critical habitat for fall Chinook is designated within the Snake River below Hells Canyon Dam, and in the Tucannon, Grande Ronde, Imnaha, Salmon, and Clearwater Rivers, and is supported by four artificial propagation programs: the Lyons Ferry Hatchery, the Fall Chinook Acclimation Ponds Program, the Nez Perce Tribal Hatchery, and Oxbow Hatchery fall-run Chinook hatchery programs (70 FR 37160).

#### *3.2.2.a Distribution*

The Snake River fall Chinook salmon ESU occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho (Figure 3.1). The Snake River fall Chinook salmon ESU includes one extant population of fish spawning in the mainstem of the Snake River and the lower reaches of several major tributaries including the Tucannon, Grande Ronde, Clearwater, Salmon, and Imnaha rivers. The ESU also includes four artificial propagation programs: the Lyons Ferry Hatchery and the Fall Chinook Acclimation Ponds Program in Washington; the Nez Perce Tribal Hatchery in Idaho; and the Oxbow Hatchery in Oregon and Idaho (70 FR 37160). Historically, this ESU also included a large population that spawned in the mainstem of the Snake River upstream of the Hells Canyon Dam complex, which is currently an impassable barrier to migration (NMFS, 2015).

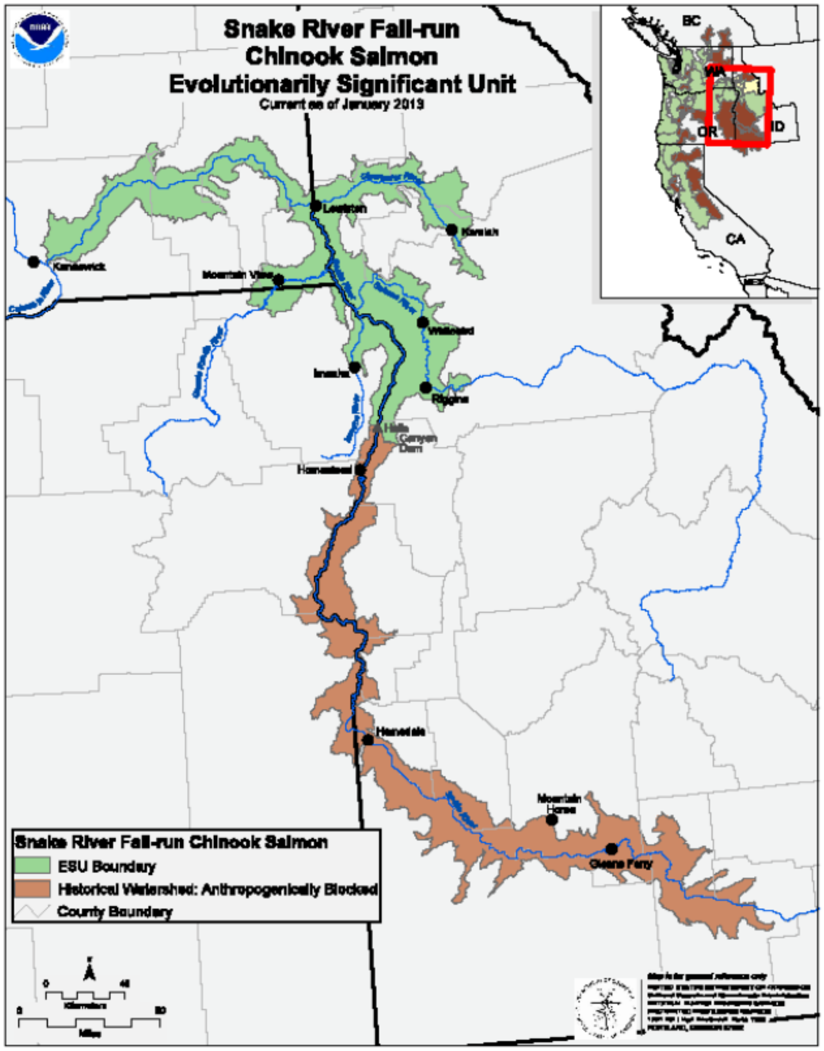


***Figure 3.1. Map of fall Chinook ESU (Source: NMFS, West Coast Region Species Maps and Data. https://www.westcoast.fisheries.noaa.gov/maps_data/Species_Maps_Data.html).***

### *3.2.2.b Life History*

Snake River fall Chinook salmon enter the Columbia River in July and August and migrate past the lower Snake River mainstem dams from August through November. Spawning takes place from October through early December in the mainstem of the Snake River, primarily between Asotin Creek and Hells Canyon Dam, and in the lower reaches of several of the associated major tributaries including the Tucannon, Grande Ronde, Clearwater, Salmon, and Imnaha rivers (Connor and Burge, 2003; Ford et al., 2011). On their upstream migration adults make extensive use of cold-water patches (refuge) often at tributary confluences (Keefer et al., 2018). Fall Chinook salmon tend to use large, lower elevation streams or mainstem areas. Spawning has occasionally been observed in the tailrace areas of the four mainstem dams (Dauble et al.,1999). Juveniles emerge from the gravels in March and April of the following year. Following emergence, the juveniles disperse from upstream natal areas downstream, April through late June (Connor et al, 2002). By July, water temperatures are high (>20 $^{0}$C) in the natal areas and the subyearlings have usually migrated downstream into the reservoir below the Snake/Clearwater rivers for thermal refuge where they use the shoreline as rearing habitat. This area is important rearing area for subyearlings or for active migrants that delay or slow their downstream movements through this area. Shallow shoreline areas are used for feeding and protection from predators. Tiffan and Connor (2012) showed that young-of-year fish favor water less than 1.8 m deep. As temperatures warm and the juveniles gain in size, they move offshore to begin outmigration in summer as subyearlings (Connor and Burge, 2003).

Until relatively recently, Snake River fall Chinook were assumed to follow an "ocean-type" life history (Dauble and Geist, 2000; Good et al. (2005); Healey 1991; NMFS, 1992) where they migrate to the Pacific Ocean during their first year of life, normally within three months of emergence from spawning substrate (as young-of-year smolts), to spend their first winter in the ocean. Ocean-type Chinook salmon juveniles tend to display a "rear as they go" strategy in which they continually move downstream through shallow shoreline habitats during the first summer and fall until they reach the ocean by winter (Connor and Burge 2003; Coutant and Whitney, 2006). They feed on insects, both aquatic larval forms and terrestrial adults (Tiffan et al., 2014).

Presently, a substantial number Snake River fall Chinook juveniles exhibit a "reservoir-type" life history (Connor et al., 2002). Analysis of fish scales taken from non-hatchery, adult, fall-run Chinook salmon indicate that approximately half of the returns passing Lower Granite Dam are reservoir-type Snake River fall Chinook that overwintered in freshwater (Ford et al., 2011). A more recent microchemistry analysis of otoliths from 124 wild and hatchery adult fall Chinook otolith estimated 76% used the yearling outmigration strategy (Chittaro et al., 2018). Reservoir-type subyearlings begin their seaward migration later than ocean-types, arrest their migration and overwinter in reservoirs on the Snake and Columbia Rivers, then resume migration in late winter/spring, entering the ocean as age-1 smolts (Connor and Burge, 2003; Connor et al., 2002; Connor et al., 2005; Hegg et al. 2013). Reservoir-type juveniles migrated substantial distances in winter in contrast to stream-type outmigrating Chinook (Tiffan et al., 2012). Within reservoir reaches, mysids and amphipods are important prey items (Tiffan et al., 2014). Connor et al. (2005) notes this switch in life history is a successful response to large scale changes to historical habitat conditions.

As in the lotic areas, outmigrants use shorelines of the reservoir for feeding and cover. These fish also avoid predators by using water depth and pelagic orientation, instead of other structural and hydraulic complexity and variability that would be found in natural streams (Tiffan et al. 2012).

#### *3.2.2.c Stressors and Threats*

With hydrosystem development, the most productive areas of the Snake River Basin are now inaccessible or inundated. The upper reaches of the mainstem Snake River were the primary areas used by fall-run Chinook salmon, with only limited spawning activity reported downstream from river kilometer (Rkm) 439. The construction of Brownlee Dam (1958; Rkm 459), Oxbow Dam (1961; Rkm 439), and Hells Canyon Dam (1967; Rkm 397) eliminated the primary production areas of Snake River fall-run Chinook salmon. There are now 12 dams on the mainstem Snake River, and they have substantially reduced the distribution and abundance of fall-run Chinook salmon (Irving and Bjornn, 1981). Beyond this major perturbation there are numerous stressors that impact this ESU to Snake River fall Chinook salmon include commercial and recreational harvest, bycatch, and natural predation; reduced habitat and prey quality and quantity; and impeded migration pathways. Within the Snake River Basin, the following stressors impact this ESU.

Throughout the basin, land management has resulted in streams becoming straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations. Reduced summer streamflow's, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in non-wilderness areas. Spawning and rearing habitat quality in tributary streams in the Snake River varies from excellent in wilderness and roadless areas to poor in areas subject to intensive human land uses (NMFS, 2017a). Critical habitat throughout much of the Interior Columbia (which includes the Snake River and the Middle Columbia River [MCR]) has been degraded by intensive agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, and livestock grazing practices.

Water diversions have substantially reduced flows of many stream reaches designated as critical habitat in the Snake River basin, (NMFS, 2017a). Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence et al. 1996).

Many stream-reaches designated as critical habitat in the Snake River basin are on the Clean Water Act 303(d) list for impaired water quality (e.g., due to elevated water temperature) (IDEQ, 2011; IDEQ, 2016). Areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevated stream temperatures. Water quality in spawning and rearing areas in the Snake River has also been impaired by high levels of sedimentation and by metal contamination potentially from mine waste (IDEQ, 2001; IDEQ and USEPA, 2003).

The development and operation of dams and reservoirs on the mainstem Columbia and Snake Rivers has severely degraded migration habitat quality for Snake River fall Chinook salmon (NMFS, 2008). Hydroelectric development has modified natural flow regimes in the migration corridor causing higher water temperatures in late summer and fall. Other effects include increased rates of piscivorous predation on juvenile salmon due to changes in fish community structure, increased rates of avian predation on juvenile salmon, and delayed migration for both adult and juveniles. Physical features of dams, such as turbines, also kill migrating fish.

In addition, the continued straying by nonnative hatchery fish into natural production areas is another threat to local, native populations.

Climate change is another factor affecting the range-wide status of Chinook salmon, and aquatic habitat at large. For example, salmon abundance is substantially affected by climate variability in freshwater and marine environments, particularly by conditions during early life-history stages of salmon (NMFS, 2008). Sources of variability include inter-annual climatic variations (e.g., El Niño and La Niña), longer term cycles in ocean conditions (e.g., Pacific Decadal Oscillation, Mantua et al., 1997), and ongoing global climate change. For example, climate variability can affect ocean productivity in the marine environment and water storage (e.g. snowpack) and instream flow in the freshwater environment. Early life-stage growth and survival of salmon can be negatively affected when climate variability results in conditions that hinder ocean productivity (e.g., Scheuerell and Williams, 2005) and/or water storage in marine and freshwater systems, respectively. Severe flooding in freshwater systems can also constrain salmon populations (NMFS, 2008).

### *3.2.2.d Population Trends and Risk*

Snake River fall-run Chinook salmon remained stable at high levels of abundance through the first part of the 20th century, but then declined substantially. Although the historical abundance of fall-run Chinook salmon in the Snake River is difficult to estimate, adult returns appear to have declined by three orders of magnitude since the 1940s, and perhaps by another order of magnitude from pristine levels. Irving and Bjornn (1981) estimated that the mean number of fall-run Chinook salmon returning to the Snake River declined from 72,000 during the period 1938 to 1949, to 29,000 during the 1950s. Further declines occurred upon completion of the Hells Canyon Dam Complex, which blocked access to primary production areas in the late 1950s. Estimated returns of naturally produced adults from 1985 through 1993 range from 114 to 742 fish (NMFS 1995).

For the Snake River fall-run Chinook salmon ESU, NMFS estimated that the median population growth rate (lambda) over a base period from 1980 through 1998 ranges from 0.94 to 0.86, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (McClure et al., 2000). The Snake River component of the fall Chinook run has been increasing during the past few years due to hatchery and supplementation efforts in the Snake and Clearwater River Basins. In 2002, more than 15,200 fall Chinook were counted past the two lower dams on the Snake River, with about 12,400 counted above Lower Granite Dam. These adult returns are about triple the 10-year average at these Snake River projects (FPC 2003).

NMFS included the following summary in their *Endangered Species Act – Section 7 Consultation Biological Opinion Consultation on Remand for Operation of the Columbia River Power System and 19 Bureau of Reclamation Projects in the Columbia Basin*. (NMFS 2004):

> "In their preliminary analysis of recent returns, Fisher and Hinrichsen (2004) reported that the geometric mean abundance of naturally produced fall Chinook was 3,462 during 2001-2003, compared to 694 in 1996-2000 (a 398% increase). The slope of the population trend increased 8.0% (from 1.16 to 1.24) when the data for 2001-2003 were added to the 1990-2000 series. These results indicate that at least for the short-term, the population has been increasing. Approximately 64% of the aggregate run at Lower Granite Dam was hatchery fish in 2001-2003, compared to 67% during 1990-2000 (Fisher, 2004).

According to NMFS's *2015 Pacific Salmon and Steelhead Status Review Update* (NWFSC, 2015) and *2016 5-Year Review of Snake River Salmon and Steelhead* (NMFS, 2016a): "Overall, while new information indicates an improvement in ESU abundance, uncertainty about population productivity and diversity indicate that the biological risk category has not changed enough since the last status review to achieve the desired viability status of highly viable and support delisting."

More recently, fall Chinook returns have declined overall (approximately 50% of the 10-year average 2007-2017 in 2017), and SR fall-run returns also reflect this downturn. Table 3.5 (below) from Peterson et al. (2018) shows the counts for returning fall Chinook at the Bonneville Dam over the past 20 years.

***Table 3.5. Adult returns to Bonneville Dam (Source: Peterson et al., 2018, Table ARD-02).***

**Adult returns by Year of Ocean Entry[1]**

| Year | OPIH Coho (adults:smolts) | Bonneville spring Chinook (n) | Bonneville fall Chinook (n) | Klamath River fall Chinook (n est.) |
|---|---|---|---|---|
| 1998 | 0.0128 | 178,302 | 192,793 | 123,856 |
| 1999 | 0.0227 | 391,367 | 400,205 | 187,333 |
| 2000 | 0.0459 | 268,813 | 473,786 | 160,788 |
| 2001 | 0.0258 | 192,010 | 610,075 | 191,948 |
| 2002 | 0.0399 | 170,152 | 583,332 | 78,943 |
| 2003 | 0.0282 | 74,038 | 417,057 | 65,227 |
| 2004 | 0.0193 | 96,456 | 299,161 | 61,374 |
| 2005 | 0.0238 | 66,624 | 161,256 | 132,131 |
| 2006 | 0.0250 | 125,543 | 314,995 | 70,554 |
| 2007 | 0.0255 | 114,525 | 283,691 | 100,644 |
| 2008 | 0.0461 | 244,385 | 467,524 | 90,860 |
| 2009 | 0.0251 | 167,097 | 401,576 | 101,977 |
| 2010 | 0.0234 | 158,075 | 350,083 | 295,322 |
| 2011 | 0.0092 | 83,299 | 952,944 | 165,025 |
| 2012 | 0.0174 | 188,078 | 854,503 | 160,396 |
| 2013 | 0.0675 | 220,250 | 954,140 | 77,821 |
| 2014 | 0.0131 | 137,176 | 440,945 | 24,582 |
| 2015 | 0.0128 | 83,616 | 316,833 | 31,838[2] |
| 2016 | 0.0156 | 87,890 | 186,862 | — |
| 2017 | 0.0171[2] | — | — | — |

[1] Counts of spring and fall Chinook salmon are lagged by 2 years. Return ratios for coho salmon are lagged by 1 year.
[2] Estimate based on jack returns.

The following figure depicts interannual variability in total fall-Chinook returns to the Lower Granite Dam, indicating that a steep decline occurred in 2017 and 2018 (Figure 3.2). Further, the Snake River Fall-run natural origin Chinook have also steeply declined (Table 3.6).

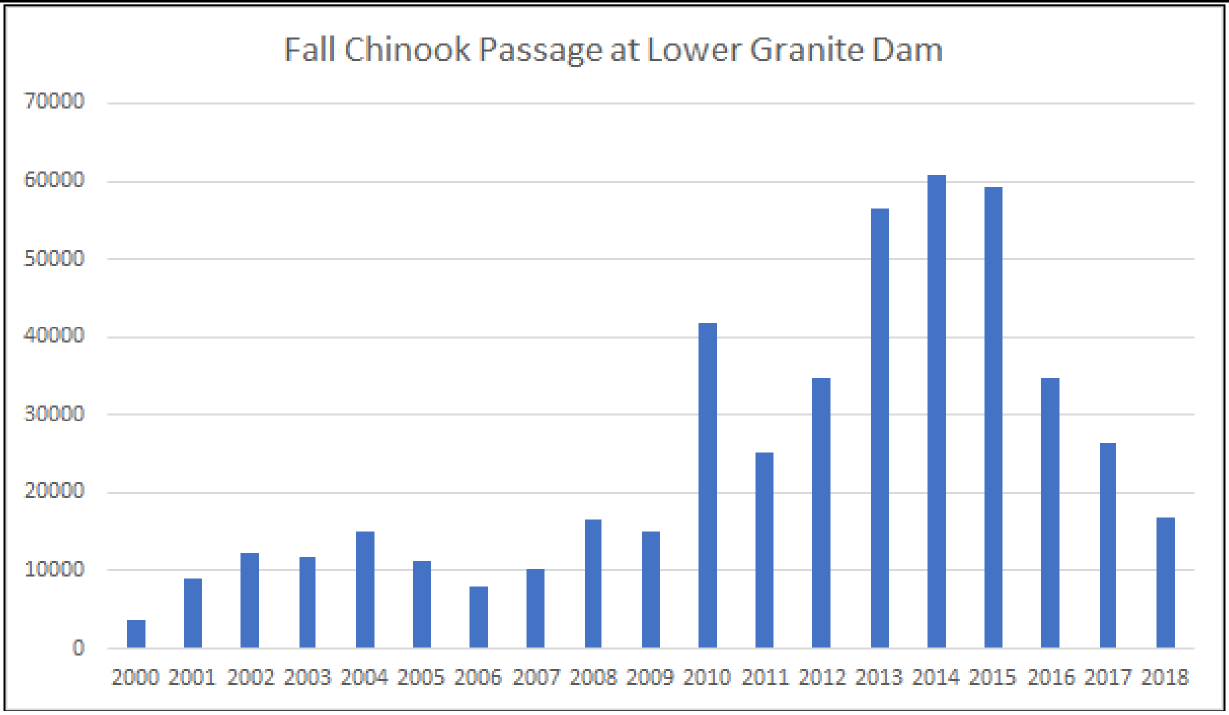


***Figure 3.2. Interannual fall Chinook adult return data at Lower Granite Dam. (Source: Columbia River DART)***

***Table 3.6. Estimated Columbia River return of Snake River natural origin fall Chinook adults 1986-2017(Source: Table 5 in WDFW, ODFW joint status report, 2018).***

| Year | Columbia River Return | Non-Treaty Zone 1-5 Harvest | Bonneville Dam Count | Treaty Zone 6 Harvest | Non-Treaty Above BON Harvest[1] | Lower Granite Run Size[2] |
|---|---|---|---|---|---|---|
| 1986 | 2,830 | 652 | 2,178 | 723 | 12 | 449 |
| 1987 | 1,783 | 491 | 1,292 | 379 | 2 | 253 |
| 1988 | 3,558 | 944 | 2,614 | 965 | 7 | 368 |
| 1989 | 1,981 | 373 | 1,608 | 608 | 8 | 295 |
| 1990 | 508 | 71 | 437 | 169 | 2 | 78 |
| 1991 | 1,846 | 275 | 1,571 | 379 | 17 | 318 |
| 1992 | 1,289 | 112 | 1,178 | 202 | 6 | 549 |
| 1993 | 1,475 | 107 | 1,368 | 270 | 11 | 742 |
| 1994 | 958 | 0 | 958 | 173 | 1 | 406 |
| 1995 | 1,296 | 10 | 1,286 | 225 | 9 | 350 |
| 1996 | 1,729 | 95 | 1,634 | 350 | 3 | 639 |
| 1997 | 1,839 | 99 | 1,740 | 459 | 7 | 797 |
| 1998 | 730 | 21 | 709 | 165 | 4 | 306 |
| 1999 | 2,395 | 163 | 2,232 | 515 | 11 | 905 |
| 2000 | 2,612 | 179 | 2,432 | 520 | 9 | 1,148 |
| 2001 | 14,133 | 778 | 13,355 | 2,020 | 63 | 5,163 |
| 2002 | 3,665 | 250 | 3,416 | 709 | 11 | 2,116 |
| 2003 | 8,093 | 675 | 7,417 | 953 | 33 | 4,257 |
| 2004 | 8,174 | 706 | 7,467 | 877 | 21 | 7,055 |
| 2005 | 9,500 | 779 | 8,721 | 1,434 | 49 | 5,299 |
| 2006 | 12,202 | 928 | 11,274 | 2,136 | 34 | 4,713 |
| 2007 | 9,878 | 567 | 9,311 | 1,492 | 64 | 3,914 |
| 2008 | 8,738 | 622 | 8,115 | 1,615 | 30 | 3,937 |
| 2009 | 15,576 | 1,568 | 14,008 | 3,831 | 53 | 4,653 |
| 2010 | 12,855 | 971 | 11,884 | 2,141 | 34 | 7,302 |
| 2011 | 17,156 | 2,228 | 14,928 | 2,918 | 53 | 8,370 |
| 2012 | 19,360 | 2,641 | 16,719 | 3,433 | 61 | 12,797 |
| 2013 | 34,669 | 3,462 | 31,208 | 6,429 | 141 | 21,124 |
| 2014 | 20,752 | 2,484 | 18,268 | 4,096 | 32 | 14,172 |
| 2015 | 24,054 | 2,530 | 21,523 | 4,319 | 87 | 16,212 |
| 2016 | 14,493 | 2,023 | 12,568 | 2,907 | 96 | 9,772 |
| 2017 | 11,750 | 1,403 | 10,997 | 3,308 | 86 | 6,966 |

[1] *Recent year harvest data for non-treaty recreational fisheries upstream of Bonneville Dam considered preliminary until catch record card data is finalized.*

[2] *Includes release mortalities*

### *3.2.2.e Critical Habitat*

Critical habitat for Snake River fall-run Chinook salmon was designated in 1993 and modified on March 9, 1998 (NMFS, 1993; NMFS, 1998). It includes the Deschutes River and reaches of the Columbia, Snake, and Salmon Rivers and passable tributaries of the Snake and Salmon Rivers. The geographic extent of critical habitat is the Snake River to Hells Canyon Dam; Palouse River from its confluence with the Snake River upstream to Palouse Falls; Clearwater River from its confluence with the Snake River upstream to Lolo Creek; North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam; and all other river reaches presently or historically accessible within the Lower Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower Salmon, Lower Snake, Lower Snake–Asotin, Lower North Fork Clearwater, Palouse, and Lower Snake–Tucannon subbasin. SR Fall Chinook PBFs are compiled in Table 3.4.

### *3.2.2.f Use of the Action Area*

The Action Area is within the Snake River fall Chinook salmon migration corridor, which is used by both adults migrating to upstream spawning habitat and by smolts out-migrating to the ocean (NPCC 2004). The bimodal distribution of Chinook salmon counts at Lower Granite Dam show the run timing distinction between the spring-summer and fall Chinook (Figure 3.3). Adult Chinook passage counts at Lower Granite Dam by year (Source: University of Washington DART data base. Accessed February 8th, 2019). Note bimodal distribution showing the spring-summer and fall runs). Returning adult fall Chinook salmon migrate upstream through this section of the Snake River from May through September and smolts migrate downstream through the area primarily from April through October. The occurrence of fall Chinook within the tributary streams is unlikely, as these fish are mainstem spawners and the species primarily occupies the larger river channels.

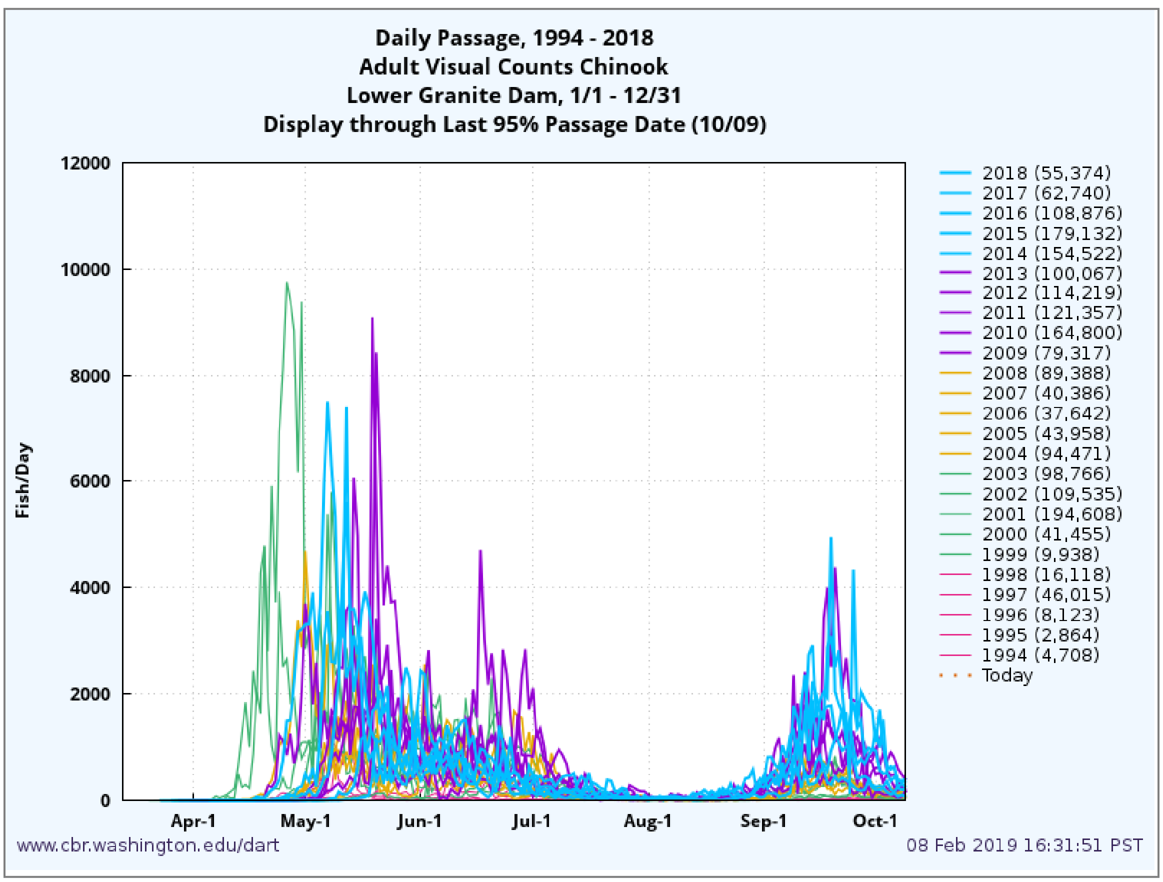


***Figure 3.3. Adult Chinook passage counts at Lower Granite dam by year (Source: University of Washington DART data base. Accessed February 8th, 2019). Note bimodal distribution showing the spring-summer and fall runs.***

Orientation within the main river water column is not specifically known for adult fall Chinook. However, hydroacoustic surveys found larger fish are typically oriented in close proximity to the bottom in the Lower Granite Reservoir (USACE, 1991). Out-migrating juveniles were located throughout the water column with the greatest concentration in the upper 15 meters. Sub-yearling Chinook use shoreline areas of islands and other shallow areas within the LGDP during migration (Bennett et al., 1993).

#### *3.2.2.f.1 Timing and Abundance Data*

Fall Chinook passage data has been collected at the Lower Granite Dam beginning in 1975 and are available from the DART database.[5] These data are collected at the dam starting on August 18 and ending on December 15th, as the USACE considers this time frame the counting window (USACE as cited at http://www.cbr.washington.edu/dart/adultruns.html). This window of data collection effort may not capture the earliest dates of passage. Data for 2006 through 2015 are presented to describe abundance and passage near the Action Area.

Upstream passage of adult fall Chinook into the Lower Granite Reservoir occurred from late August to early November (Table 3.7 and Figure 3.4). The date of early passage for the Lower Granite Dam is August 17, 2008 and 2012 (earliest date of data collection) and the date of late passage is assumed to be December 15, 2010 (latest date of data collection). Thus, data presented in Table 3.7 collected from 2006 through 2015 reflects the start of monitoring rather than the date of first passage. For these years, the data end between December 2 (in 2009) and December 15 (in 2010).

***Table 3.7. Dates of Adult Fall Chinook Passage at Lower Granite Dam 2006 - 2016.***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 8/18 | 8/30 | 9/18 | 10/16 | 12/3 |
| 2007 | Average | 8/18 | 8/31 | 9/21 | 10/20 | 12/3 |
| 2008 | Average | 8/17 | 8/31 | 9/12 | 10/09 | 12/4 |
| 2009 | Average | 8/18 | 8/29 | 9/14 | 10/16 | 12/2 |
| 2010 | Average | 8/18 | 9/3 | 9/19 | 10/15 | 12/15 |
| 2011 | High | 8/18 | 8/28 | 9/19 | 10/21 | 12/7 |
| 2012 | Average | 8/17 | 9/2 | 9/18 | 10/11 | 12/12 |
| 2013 | Average | 8/18 | 9/5 | 9/20 | 10/13 | 12/4 |
| 2014 | Average | 8/18 | 9/3 | 9/20 | 10/13 | 12/4 |
| 2015 | Low | 8/18 | 9/1 | 9/19 | 10/15 | 12/14 |

[5] http://www.cbr.washington.edu/dart/adultruns.html

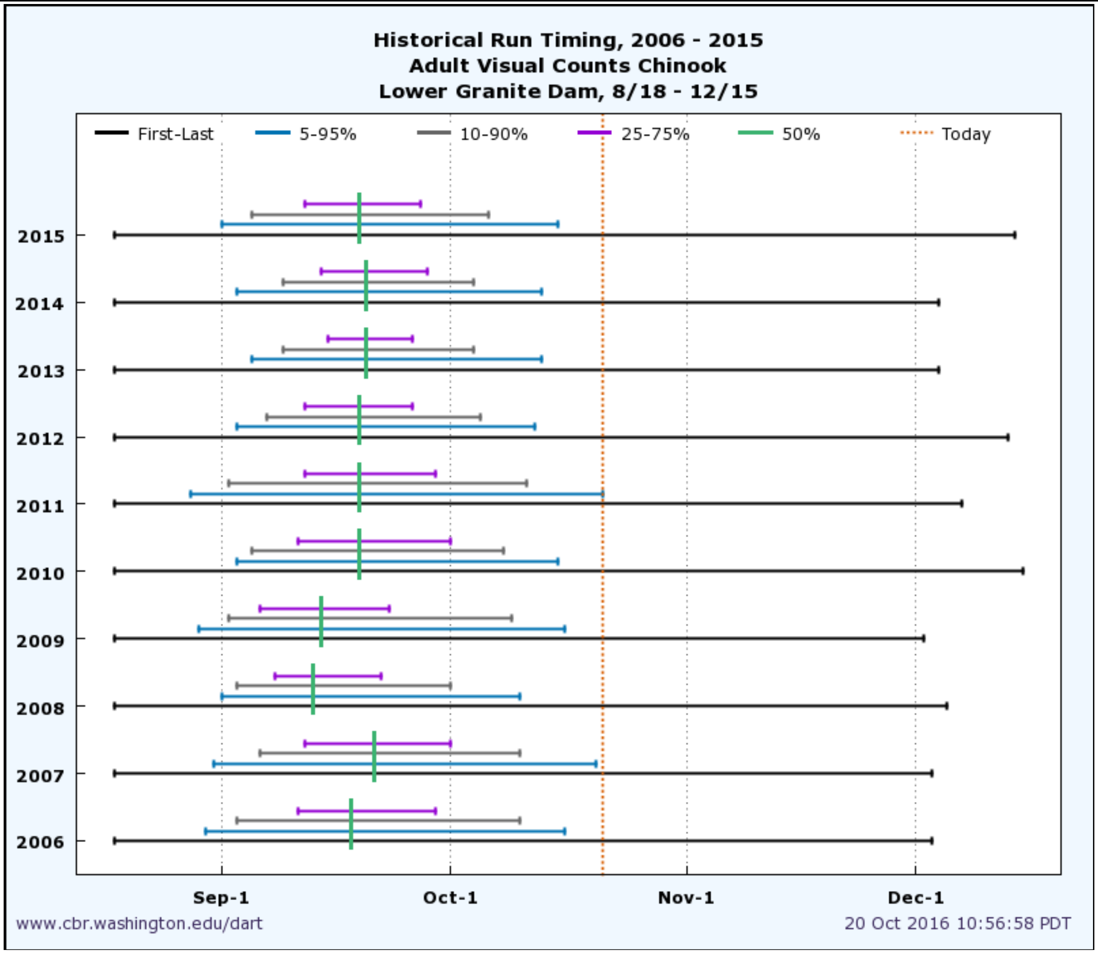


***Figure 3.4. Average adult fall Chinook passage at Lower Granite Dam, 2006 - 2015 (source: DART).***

Dam passage data, obtained through the University of Washington's Columbia Basin Research DART website, show that the sub-yearling Chinook are passing through the LGDP from before March 26 (in 20–1 - 2015) through November 1 (in 2006, 2008, 2011), respectively (Table 3.8 and Figure 3.5). Most out-migrating sub-yearling wild fall Chinook passed over the Lower Granite Dam in June and July in sampled years 2006 to 2015. During this time period, total numbers of fish for each year ranged from approximately 338,000 (2007) to 1,177,374 (2011). The timeframe for the majority of wild fall Chinook out-migration is relatively narrow (during June, July, and August over the monitored years) and the fraction of the total population out-migrating during a given week is relatively constant from one year to another.

***Table 3.8. Dates of sub-yearling wild fall Chinook passage at Lower Granite Dam 2006 - 2015 (source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 3/31 | 5/20 | 6/5 | 7/8 | 11/1 |
| 2007 | Average | 3/30 | 6/1 | 6/10 | 7/28 | 10/31 |
| 2008 | Average | 4/3 | 5/23 | 6/16 | 8/9 | 11/1 |
| 2009 | Average | 4/2 | 5/26 | 6/9 | 7/11 | 10/31 |
| 2010 | Average | 3/27 | 5/31 | 6/8 | 7/26 | 10/31 |
| 2011 | High | 3/26 | 5/20 | 6/10 | 7/24 | 11/1 |
| 2012 | Average | 3/26 | 5/23 | 6/14 | 7/22 | 10/31 |
| 2013 | Average | 3/26 | 5/24 | 6/9 | 9/3 | 10/31 |
| 2014 | Average | 3/26 | 5/26 | 6/11 | 8/6 | 10/31 |
| 2015 | Low | 3/26 | 5/25 | 6/7 | 8/3 | 10/31 |

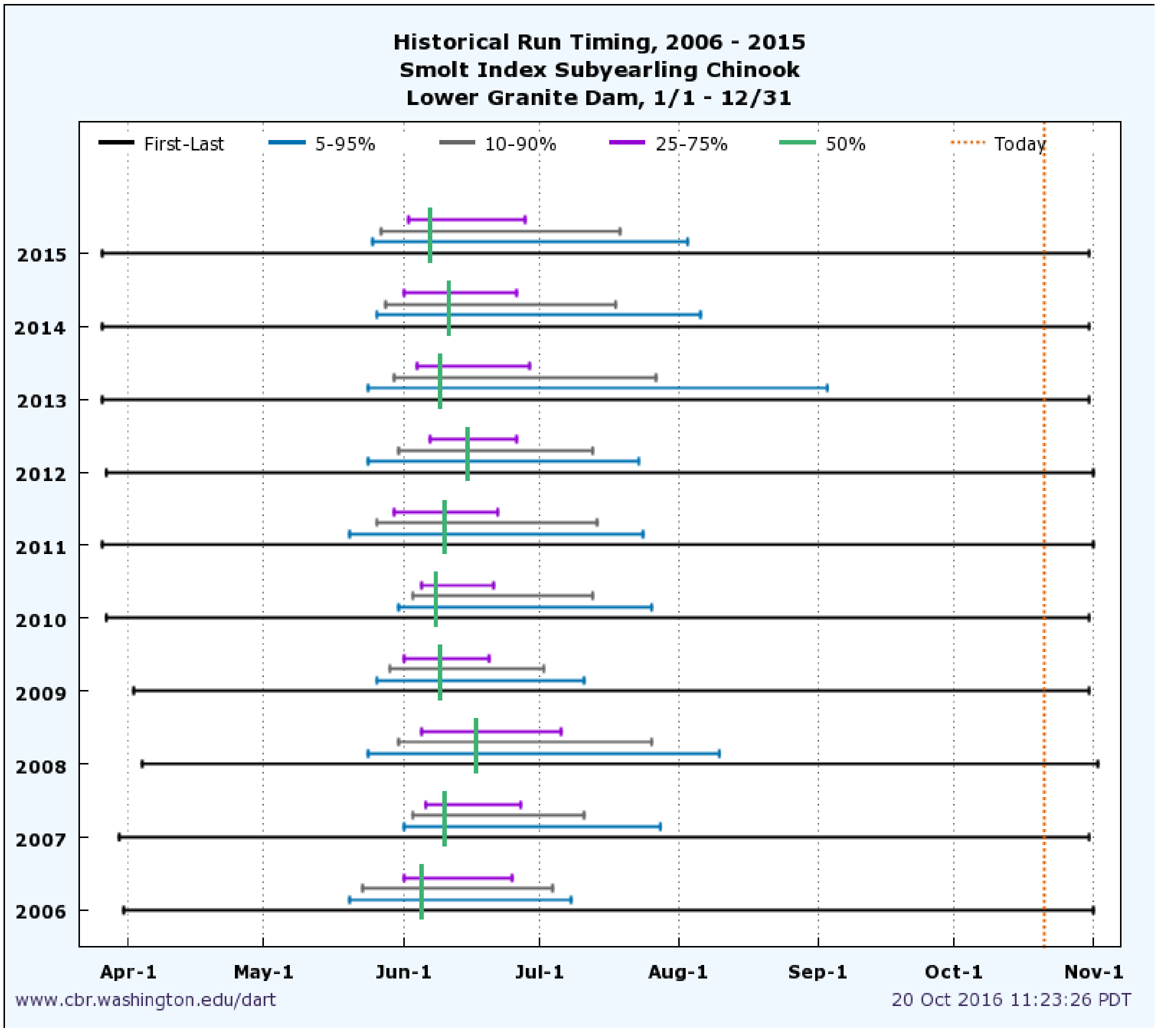


***Figure 3.5. Average sub-yearling wild fall Chinook passage at Lower Granite Dam 2006 - 2015 (source: DART)***

Currently, hatchery-reared fall Chinook make up most of the juvenile fall Chinook population in the Snake River. Downstream migrating sub-yearling hatchery fall Chinook passed over the Lower Granite Dam primarily between 2 May and 22 November in sampled years 2013 and 2010 (Table 3.9). The periods of migration through the Snake River for hatchery-reared fall Chinook were not always consistent with those of the wild population. This may be attributable to the timing of their release from the hatcheries, or other factors such as hatchling survival, predation, or passage mortality. Total numbers of hatchery fall Chinook out migrating in each year ranged from approximately 3000 (2013) to 58,000 (2012).

***Table 3.9. Sub-yearling hatchery fall Chinook passed over the Lower Granite Dam, 2006 - 2015 (source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 3/25 | 4/16 | 6/4 | 11/11 | 12/16 |
| 2007 | Average | 3/27 | 4/20 | 5/13 | 6/16 | 10/28 |
| 2008 | Average | 3/27 | 4/20 | 6/2 | 10/20 | 12/13 |
| 2009 | Average | 1/1 | 4/17 | 5/28 | 11/11 | 12/5 |
| 2010 | Average | 3/25 | 4/23 | 6/5 | 11/22 | 12/16 |
| 2011 | High | 3/23 | 4/8 | 5/30 | 8/11 | 12/15 |
| 2012 | Average | 3/22 | 4/4 | 6/3 | 11/7 | 12/20 |
| 2013 | Average | 3/18 | 4/7 | 5/2 | 6/10 | 8/8 |
| 2014 | Average | 4/5 | 4/15 | 6/2 | 7/8 | 11/11 |
| 2015 | Low | 4/3 | 4/25 | 5/29 | 6/13 | 8/31 |

### *3.2.2.f.2 Travel Time*

Keefer et al. (2002) investigated adult passage efficiency and travel time of fall Chinook at eight main-stem dams and reservoirs in the lower Columbia and Snake rivers, all major tributaries between Bonneville and Priest Rapids Dams on the Columbia River, and the Snake River and its tributaries upstream to Hells Canyon Dam during the fall (August-October) over a period of three years. Median values reported for the three-year duration ranged from 19 km/day to 31 km/day, with a mean of 27.2 km/day. Keefer et al. (unpublished manuscript, 2003) also studied fall Chinook migration speed in Columbia and Snake River reservoirs (Bonneville, Dalles, John Day, McNary to Ice harbor, McNary to Hanford receiver, Ice Harbor, Lower Monumental, Little Goose, Lower Granite to Snake River receiver, and Lower Granite to Columbia River receiver) over the same three-year duration. Median values reported for the three-year duration ranged from 8 km/day to 71 km/day, with a mean of 49.6 km/day.

Skalski et al. (1996) measured juvenile fall Chinook migration speed during both moderate and low river flows in the Columbia River, downstream of its confluence with the Snake River. At free flowing and impounded stretches, where flow rates were approximately 8500 $m^3$/s, migration speeds were 40 km/day to 55 km/day. At lower flows, approximately 4250 $m^3$/s, migration speeds were 24 km/day to 27 km/day.

For both juvenile and adult fall Chinook, a range of mean migrations speeds of approximately 25 to 50 km/day has been observed. This distance from the confluence of the Snake and Clearwater rivers and the Lower Granite Dam is approximately 31 miles, or 50 km. Given the mean migration speeds observed in the literature, fall Chinook may require one to two days to travel between the confluence of the Snake and Clearwater rivers and Lower Granite Dam.

Travel times from the free-flowing section of the Snake River through the Lower Granite Dam were calculated for sub yearling fall Chinook using pit-tagged hatchery fish (Smith et al. 2003). In this study, juveniles reared at Lyons Ferry Hatchery were released upstream at two sites on the

Snake: Pittsburg Landing (173km above dam) and Bill Creek (92 km above dam). A total of 52,813 fish were tracked 1995-2000. Sub-yearlings were detected at the Lower Granite Dam from mid to late May through the end of October when the detection system was turned off. The average travel time from the flowing portion of the river to the dam was 43.5 days. According to Connor et al. (2003), wild fall Chinook juveniles spend a significant portion of this time period rearing (feeding and growing) or dispersing passively downstream rather than actively migrating downstream.

Travel times of wild Chinook juveniles were estimated from the PIT Tag Information System (PTAGIS) database by NMFS (2003). Juveniles trapped and tagged at a Snake River and a Clearwater River trap from 1990-2003 were detected at the Lower Granite Dam allowing for estimates of travel time. This analysis has three caveats: 1) length data were available but no distinction between spring/summer and fall run fish was possible; 2) fish samples were collected from the surface, where juveniles that are actively migrating are most likely to be oriented in the water column. This may bias the sample away from the portions of the cohort that may be feeding/rearing as they progress downstream; and 3) data were collected during the peak migration, again focusing the study on one portion of the entire cohort.

Travel times were estimated in days for sub-yearling Chinook juveniles (<91mm) (Table 3.10):

***Table 3.10. Travel Times for Subyearling Chinook Juveniles***

| Snake River Trap (n=287) | | Clearwater River Trap (n=260) | |
|---|---|---|---|
| Mean | 23.9 | Mean | 25.3 |
| Median | 19.0 | Median | 21.4 |
| 99.5 percentile | 99.6 | 99.5 percentile | 77.5 |

### 3.2.3 Spring/Summer Chinook Salmon (Threatened)

The Snake River spring/summer Chinook salmon ESU was listed as threatened on April 22, 1992 (57 FR 14653) and the threatened status was reaffirmed in 2005 (70 FR 37160). In 2016, NMFS conducted a 5-year review of the status of the species and based on the best available scientific information determined that the “threatened” classification remained appropriate (NMFS 2016a; 81 FR 33468). This ESU includes all naturally spawning populations of spring/summer Chinook in the mainstem Snake River (below Hells Canyon Dam) and in the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins (57 FR 23458), as well as the progeny of 15 artificial propagation programs (70 FR 37160) (Figure 3.6). The historical Snake River spring/summer Chinook salmon ESU likely also included populations in the Clearwater River drainage and extended above the Hells Canyon Dam complex. The Clearwater drainage was not included due to loss of this population in the 1950s. Although not listed in the ESU, the reestablished Clearwater River populations need conservation consideration as part of the historical range and interactions with other populations (IDFG, 2005).

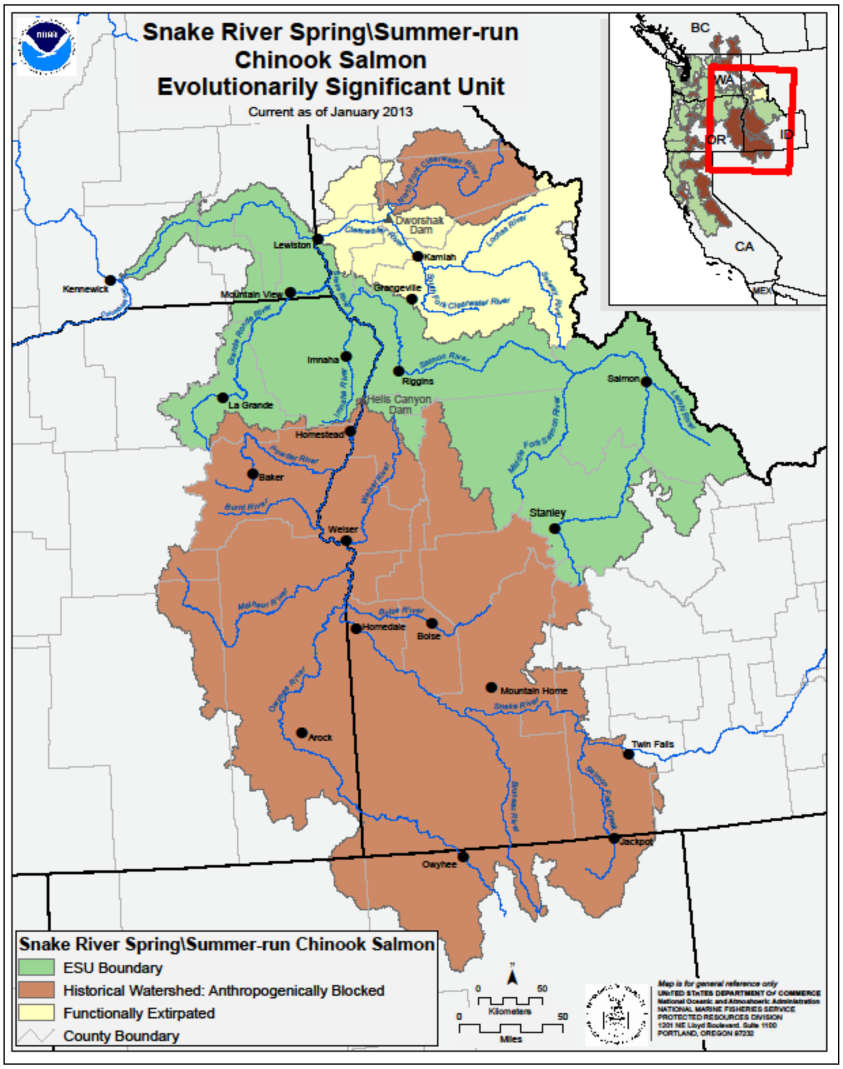


***Figure 3.6. Map of spring/summer Chinook ESU (Source: NMFS, West Coast Region Species Maps and Data). https://www.westcoast.fisheries.noaa.gov/maps_data/Species_Maps_Data.html).***

### *3.2.3.a Distribution*

Historically, spring/summer Chinook salmon spawned in practically all the accessible and suitable habitat in the Snake River (Matthews & Waples, 1991). Spawning areas included tributaries of the Clearwater, Salmon, Weiser, Payette and Boise Rivers. Populations using the rivers above Hells Canyon Dam were eliminated with the construction of Hells Canyon complex from 1955 to 1967, as well as by earlier upriver dams. Populations in the Clearwater drainage were eliminated or severely depressed by construction of the Lewiston dam in the 1950s.

Presently, Snake River spring/summer Chinook salmon occupy the Snake River basin in southeastern Washington, northeastern Oregon, and north/central Idaho. Snake River spring/summer-run Chinook salmon are found in several subbasins of the Snake River (CBFWA, 1990a, 1990b). Snake River spring/summer Chinook salmon use three small Snake River tributaries, Asotin, Granite, and Sheep Creeks, which enter the Snake River between Lower

Granite and Hells Canyon Dams. These provide spawning and rearing areas (CBFWA, 1990a, 1990b).

#### *3.2.3.b Life history*

Snake River spring/summer Chinook salmon are characterized by their return times. Spring runs are counted at Bonneville Dam beginning in early March and ending the first week of June. Summer runs include Chinook adults that pass Bonneville Dam from June through August. Returning adults will hold in deep mainstem and tributary pools until late summer, when they move up into tributary areas to spawn.

In both the Columbia and Snake Rivers, spring-run Chinook salmon tend to spawn in higher-elevation reaches of major Snake River tributaries in mid- to late August, and summer-run Chinook salmon tend to spawn lower in Snake River tributaries in late August and September. The habitats used for spawning and early juvenile rearing also differ among the two runs (Chapman et al., 1991). Summer Chinook are more variable in their spawning habitats; in the Snake River, they inhabit small, high elevation tributaries typical of spring Chinook salmon habitat, whereas in the upper Columbia River they spawn in the larger lower elevation streams characteristic of fall Chinook salmon habitat. The spawning areas of the two runs may overlap. Eggs are deposited in late summer and early fall, incubate through the winter, and hatch between late winter and early spring.

Spring/summer Chinook follow a “stream-type” life history characterized by protracted period of freshwater rearing. Juveniles rear through the summer, and most overwinter and migrate to the sea in the spring of their second year (Healey, 1991). Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas.

Yearling spring/summer Chinook salmon begin their out-migration toward the ocean between March and July, with spring run fish out-migrating a few weeks earlier than the summer run fish. Because they spend nearly a year in fresh water, these smolts are 10 to 15 inches in length when they migrate to the ocean. This enables them to move offshore fairly quickly and to undertake extensive offshore migrations (Healey, 1991; Healey, 1983).

Snake River spring/summer Chinook salmon return from the ocean to spawn primarily as four- and five-year-old fish, after two to three years in the ocean. A small fraction of the fish returns as three-year old jacks (precocious spawners), of which the majority are males (Good et al., 2005).

#### *3.2.3.c Stressors and Threats*

The ability of SR spring/summer-run Chinook salmon populations to sustain themselves through normal periods of relatively low ocean survival remains uncertain. Environmental factors that limit Snake River spring/summer run Chinook salmon are the same as those discussed above for the Snake River fall-run Chinook salmon ESU. Effects related to the hydropower system in the mainstem Columbia River, including reduced upstream and downstream fish passage, altered ecosystem structure and function, altered flows, and degraded water quality are of primary concern. Muir and Williams (2012) noted structural and operational improvements to mainstem

Snake and Columbia River hydropower dams in recent years have substantially improved Chinook salmon smolt survival, reduced travel time, and increased connectivity between rearing areas and the Pacific Ocean by restoring entry timing closer to that prior to hydropower development. Despite substantial gains in direct downstream smolt survival and improved upstream passage success through the hydropower system, smolt-to-adult return rates (SARs) have not shown the same improvement in most years. However, variable ocean conditions and increased hatchery production confound comparisons with historical SARs.

Other factors are degradation related to land use (i.e. degradation of floodplain connectivity and function, channel structure and complexity, riparian areas and large woody debris recruitment), alterations to stream flow, and water quality degradation. Finally, factors that may contribute to depressed and variable SARs include changes in ocean productivity, increased hatchery production, and the reduction in volume and turbidity of the Columbia River plume due to increased water storage in the basin (Muir and Williams, 2012).

### *3.2.3.d Population Trends and Risk*

Historically, the Snake River was estimated to produce approximately 39 percent of the total spring Chinook salmon and 45 percent of the total summer Chinook salmon in the Columbia River Basin (Mallett,1974).

The population had declined to low levels by the 1980s where spring Chinook salmon redd counts in some index areas were less than 30 percent of the 1958-62 period counts (CBFWA, 1990b; CBFWA, 1990a). As recently as 1995, the spring Chinook count in the Snake River was at the all-time low of about 1,500 fish. In 2002, the fish count at Lower Granite Dam was 75,025, which was more than double the 10-year average. Count of both hatchery and wild/natural returns to the Snake River increased in both 2001 and 2002 (FPC, 2003). In NMFS, 2004b, NMFS states the following: “In general, for most of the 24 populations where recent data were available, indices of abundance (i.e., redd counts) for natural-origin SR spring/summer Chinook were high in 2002 and 2003 compared to the 1990s.”

Population level status ratings remain at “high” risk of extinction for all major population groups within the ESU. Although recent natural spawning abundance estimates have increased, all populations remain below minimum natural origin abundance thresholds (Ford, et al 2011). Spawning escapements in the most recent years in each series are generally well below the peak returns but above the extreme low levels in the mid-1990s. Relatively low natural production rates and spawning levels below minimum abundance thresholds remain a major concern across the ESU. In NWFSC, 2015, it is stated that Spring and Summer Chinook Salmon are likely to become endangered in the future and that the risk level for this population is stable at the threatened level.

### *3.2.3.e Critical habitat*

Critical habitat for Snake River spring/summer-run Chinook salmon was designated in 1993 and 1999 and includes reaches of the Columbia, Snake, and Salmon Rivers and accessible tributaries of the Snake and Salmon Rivers (58 FR 68543 and 64 FR 57399). The geographic extent of critical habitat includes all Snake River reaches upstream to Hells Canyon Dam; all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Salmon River basin; and all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Hells Canyon, Imnaha, Lower Grande Ronde, Upper Grande Ronde, Lower Snake-Asotin, Lower Snake-Tucannon, and Wallowa subbasins. Major river basins containing spawning and rearing habitat for this ESU comprise approximately 22,390 square miles in Idaho, Oregon and Washington. SR spring/summer Chinook PBFs are compiled in Table 3.4.

### *3.2.3.f Use of the Action Area*

The Action Area is within the spring/summer Chinook salmon migration corridor used by adult and smolt life history forms. As shown by the bimodal distribution in Table 3.3, these fish arrive at lower Granite Dam between April through August. They reach their natal tributaries between June and August and spawning occurs in August and September one to four months after they begin their migration (Myers et al, 1998).

Smolts migrate downstream through the area primarily from April through June. The confluence of the Snake and Clearwater rivers is an important habitat feature, as the cold water temperatures of the Clearwater River is used by migrating fish as thermal refuge. Smolts and adult salmon often “dip-in” to non-natal rivers to rest or seek cold water refuge. Some of these fish may remain a few hours or days in-route, while others may attempt to stay for extended periods of time, such as weeks or months (NMFS, 2003).

Orientation within the water column is not specifically known for adult spring/summer Chinook. However, hydroacoustic surveys (USACE, 1991) found larger fish are typically oriented near the bottom in the Lower Granite Reservoir. Hydroacoustic surveys conducted in May and June found outmigrating juvenile salmonids were located throughout the water column with the greatest concentration in the upper 15 meters.

#### *3.2.3.f.1 Timing and Abundance Data*

Spring/summer Chinook passage data collected at the Lower Granite Dam for the years 2006 through 2015 are presented to describe passage near the Action Area (available from University of Washington DART database). Most adult spring/summer Chinook migrate upstream across the dam into the Lower Granite Reservoir from mid-April to mid-July (Table 3.11 and Figure 3.7). Migrating adult run sizes ranged from approximately 37,000 fish (2006) to 179,000 fish (2015) (DART database).

For the years 2006 through 2015, the date of early passage for the Lower Granite Dam was March 31, 2014 through May 8, 2006. The date of late passage was not determined from the Columbia River DART[6] database, which obtains data from USACE (2002), because they counted Chinook salmon without distinguishing between spring, summer, or fall Chinook. However, the convention for separating spring-, summer- and fall-run fish is based on date of passage. At the Lower Granite Dam, the spring run is considered to occur from March 1 to June 17; the summer run is considered to occur from June 18 to August 17; and the fall run is

[6] http://www.cbr.washington.edu/dart/

considered to occur from August 18 to December 15. This convention has been used to allocate fish counts from the DART database into spring/summer- and fall-run Chinook.

***Table 3.11. Dates of adult spring/summer Chinook passage at Lower Granite Adult Fishway, 2006 - 2015 (Source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 5/8 | 5/15 | 6/9 | 7/29 | 10/5 |
| 2007 | Average | 4/25 | 5/5 | 6/8 | 7/25 | 10/20 |
| 2008 | Average | 4/22 | 5/10 | 6/13 | 7/7 | 9/28 |
| 2009 | Average | 4/28 | 5/13 | 6/11 | 7/11 | 10/11 |
| 2010 | Average | 4/20 | 5/5 | 6/5 | 7/6 | 11/18 |
| 2011 | High | 4/15 | 5/11 | 6/24 | 7/27 | 10/25 |
| 2012 | Average | 5/4 | 5/18 | 6/1 | 7/16 | 9/26 |
| 2013 | Average | 4/23 | 5/8 | 6/5 | 7/5 | 8/10 |
| 2014 | Average | 3/31 | 5/7 | 6/2 | 7/4 | 11/6 |
| 2015 | Low | 4/3 | 4/29 | 5/21 | 7/28 | 9/29 |

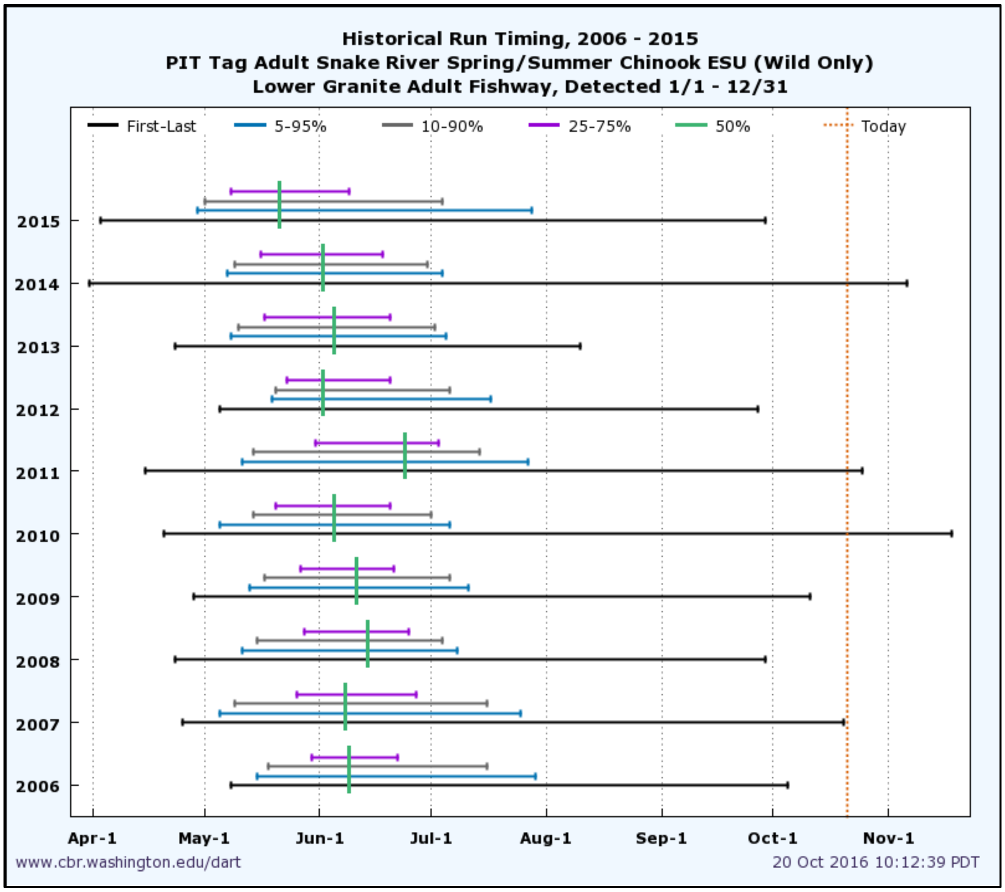


***Figure 3.7. Average of adult spring/summer Chinook passage at Lower Granite Dam, 2006 - 2015 (Source: DART).***

Downstream migrating yearling wild spring/summer Chinook passed over the Lower Granite Dam primarily between mid-April and end of May from 2006 to 2016 (Figure 3.8). Juveniles first passed through Lower Granite Reservoir from March 20, 2014, through March 31, 2010 (Table 3.12). The dates of last juvenile passage ranged from July 6, 2007, through December 12, 2012. The timing of this outmigration is relatively narrow.

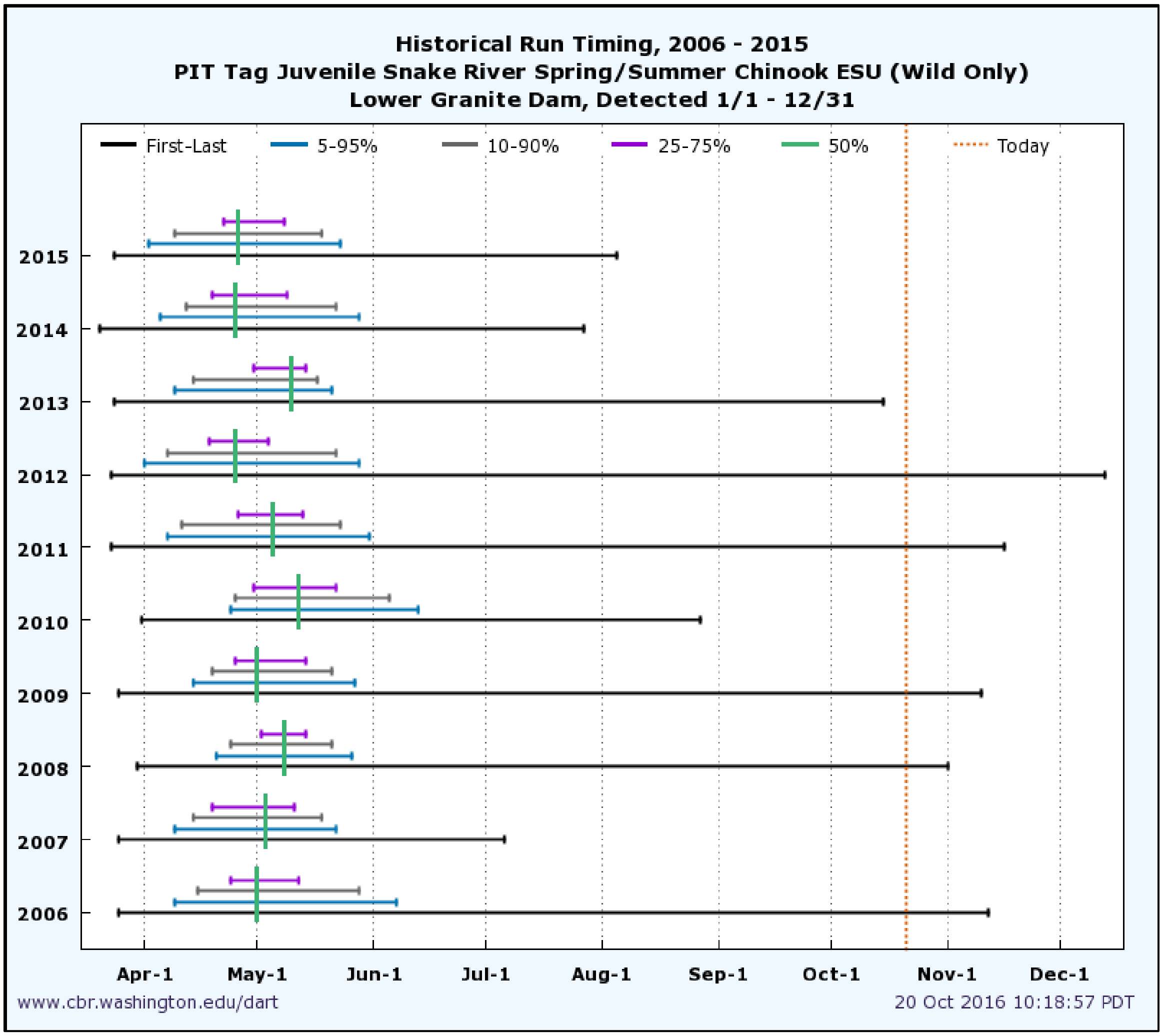


***Figure 3.8. Average wild yearling spring/summer Chinook Passage at Lower Granite Dam, 2006 - 2015 (source: DART).***

***Table 3.12. Dates of wild yearling spring/summer Chinook passage at the Lower Granite Dam, 2006 - 2015 (Source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 3/25 | 4/9 | 5/1 | 6/7 | 11/12 |
| 2007 | Average | 3/25 | 4/9 | 5/3 | 5/22 | 7/6 |
| 2008 | Average | 3/29 | 4/19 | 5/7 | 5/25 | 10/31 |
| 2009 | Average | 3/25 | 4/14 | 5/1 | 5/27 | 11/10 |
| 2010 | Average | 3/31 | 4/24 | 5/12 | 6/13 | 8/27 |
| 2011 | High | 3/23 | 4/7 | 5/5 | 5/31 | 11/16 |
| 2012 | Average | 3/22 | 3/31 | 4/24 | 5/27 | 12/12 |
| 2013 | Average | 3/24 | 4/9 | 5/10 | 5/27 | 11/10 |
| 2014 | Average | 3/20 | 4/5 | 4/25 | 5/28 | 7/27 |
| 2015 | Low | 3/24 | 4/2 | 4/26 | 5/23 | 8/5 |

Although wild spring/summer Chinook are the focus of this analysis, hatchery-reared fish make up most of the juvenile spring/summer Chinook population in the Snake River. Downstream migrating yearling hatchery spring/summer Chinook passed over the Lower Granite Dam primarily between mid-April and end of May from 2006 to 2015 (Figure 3.9). The dates of first passage ranged from March 28, 2012, to April 18, 2010 (Table 3.13). The dates of last passage ranged from June 9, 2015, to July 17, 2011. The periods of migration through the Lower Snake River for hatchery-reared Chinook were comparable to those for wild spring/summer Chinook.

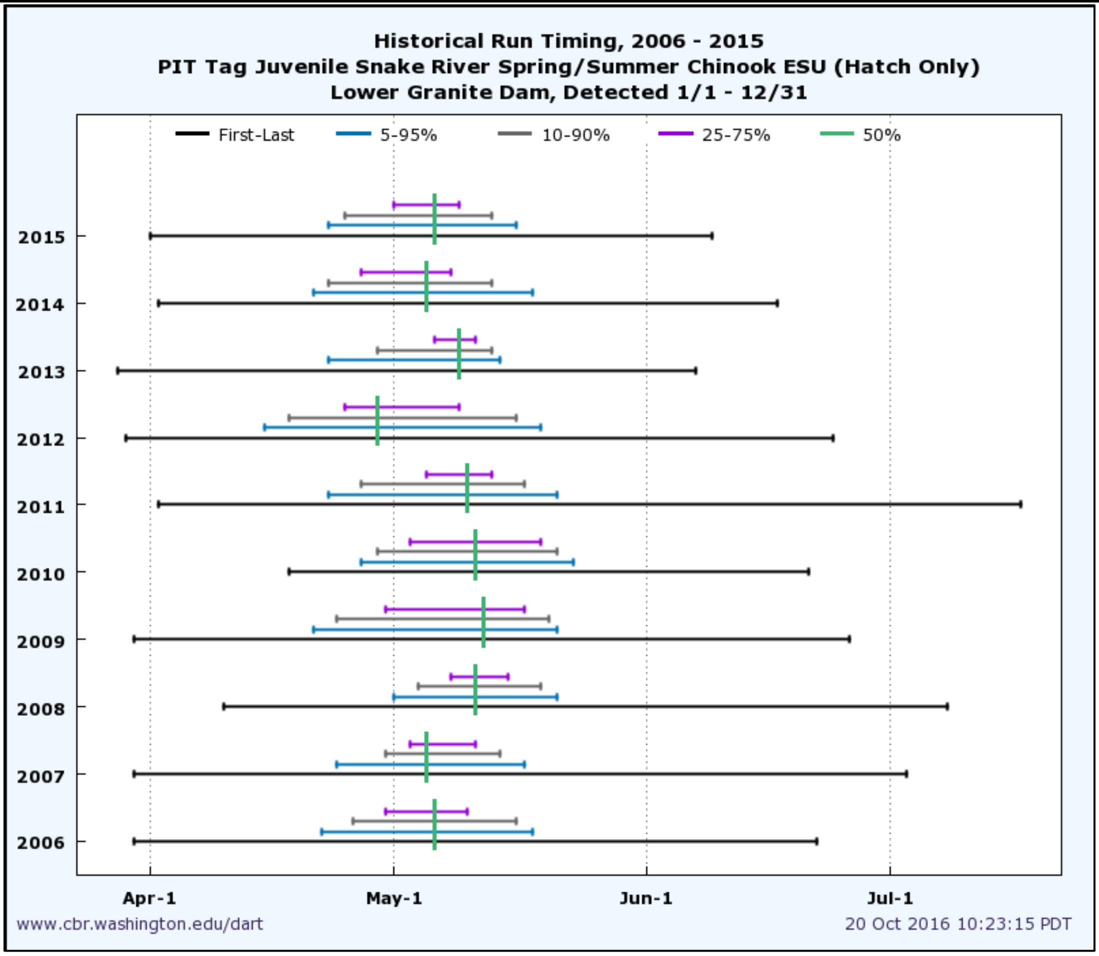


***Figure 3.9. Average hatchery yearling spring/summer Chinook passage at Lower Granite Dam, 2006 - 2015 (source: DART).***

***Table 3.13. Dates of hatchery yearling spring/summer Chinook passage at Lower Granite Dam, 2006 - 2015 (source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 3/30 | 4/22 | 5/6 | 5/18 | 6/22 |
| 2007 | Average | 3/30 | 4/24 | 5/5 | 5/17 | 7/3 |
| 2008 | Average | 4/9 | 4/30 | 5/10 | 5/20 | 7/7 |
| 2009 | Average | 3/30 | 4/21 | 5/12 | 5/21 | 6/26 |
| 2010 | Average | 4/18 | 4/27 | 5/11 | 5/23 | 6/21 |
| 2011 | High | 4/2 | 4/23 | 5/10 | 5/21 | 7/17 |
| 2012 | Average | 3/28 | 4/14 | 4/28 | 5/18 | 6/23 |
| 2013 | Average | 3/28 | 4/14 | 4/28 | 5/18 | 6/23 |
| 2014 | Average | 4/2 | 4/21 | 5/5 | 5/18 | 6/17 |
| 2015 | Low | 4/1 | 4/23 | 5/6 | 5/16 | 6/9 |

### *3.2.3.f.2 Travel time*

The DART database was used to estimate travel time for juvenile Chinook. Most recent annual data showed travel time for spring/summer Chinook during March through October. Migration speeds ranged from 2.1 km/day to 21.2 km/day, with a mean migration speed of 11.8 km/day. Wild and hatchery adult spring/summer Chinook salmon are monitored by DART as well, with 2003 mean velocities of 6.35 and 5.88 km/day, respectively. Keefer et al. (2003) measured migration speed of adult spring/summer Chinook at eight main-stem dams and reservoirs in the lower Columbia and Snake rivers, all major tributaries between Bonneville and Priest Rapids dams on the Columbia River and the Snake River and its tributaries upstream to Hells Canyon Dam during the spring (April-May) over a period of five years. Median values reported for the five-year duration ranged from 12 km/day to 38 km/day, with a mean of 25.7 km/day. Keefer et al. (2003) also studied adult spring/summer Chinook migration speed in Columbia and Snake River reservoirs (Bonneville, Dalles, John Day, McNary to Ice harbor, McNary to Hanford receiver, Ice Harbor, Lower Monumental, Little Goose, Lower Granite to Snake River receiver, and Lower Granite to Columbia River receiver) over the same five-year period. Median values reported for the five-year duration ranged from 16 km/day to 83 km/day, with a mean of 61.3 km/day. Bjornn et al. (2000) also studied adult spring/summer Chinook migration speed through pools. Migration speeds ranged from 43.2 km/day to 61.5 km/day, with a mean of 51.4 km/day.

A range of mean migrations for adult spring/summer Chinook of approximately 12 to 50 km/day has been observed. The distance from the Lower Granite Dam to the confluence of the Snake and Clearwater rivers is approximately 31 miles, or 50 km. Given the mean migration speeds observed in the literature, adult spring/summer Chinook may require one to four days to travel between the Lower Granite Dam the Clearwater and Snake river confluence.

As presented in the section discussion the spring/summer Chinook, travel times of wild Chinook juveniles were estimated from the PTAGIS database by NMFS (2003). Juveniles trapped and tagged at a Snake River and a Clearwater River trap from 1990-2003 were detected at the Lower Granite Dam allowing for estimates of travel time. This analysis has three caveats: 1) length data were available but no distinction between spring/summer and fall run fish was possible; 2) fish samples were collected from the surface, where juveniles that are actively migrating are most likely to be oriented in the water column. This may bias the sample away from the portions of the cohort that may be feeding/rearing as they progress downstream; and 3) data were collected during the peak migration, again focusing the study on one portion of the entire cohort.

The following travel times were estimated in days for yearling Chinook juveniles (>90 mm):

***Table 3.14. Travel Times for Yearling Chinook Juveniles***

| Snake River Trap (n=4770) | | Clearwater River Trap (n=1045) | |
|---|---|---|---|
| Mean | 7.3 | Mean | 13.8 |
| Median | 5.5 | Median | 11.9 |
| 99.5 percentile | 29.8 | 99.5 percentile | 52.8 |

### 3.2.4 Sockeye Salmon (Endangered)

The Snake River sockeye salmon ESU was first listed as endangered under the ESA in 1991, and the listing was reaffirmed in 2005 (70 FR 37160). On May 26, 2016, in the most recent five-year review for Pacific salmon and steelhead (NMFS, 2016a), the NMFS concluded that the species should remain listed as endangered (81 FR 33468).

#### *3.2.4.a Distribution*

This ESU includes all anadromous and resident sockeye salmon from the Snake River basin in Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive propagation program. Extant populations of sockeye salmon only occur in the Stanley basin of Idaho. The non-anadromous form (kokanee), found in Redfish Lake and elsewhere in the Snake River Basin, is included in the ESU.

Numbers of Snake River sockeye salmon have declined dramatically over the years. In Idaho, only the lakes of the upper Salmon River (Stanley Basin) remain as potential sources of production. Currently, Snake River sockeye salmon spawn in Redfish, Alturas, and Pettit Lakes (NMFS, 2015b; USFWS, 2017). The Stanley Basin lakes are located within the Sawtooth National Recreation Area. Basin lakes are glacial-carved and receive runoff from the east side of the Sawtooth and Smoky mountains. All Basin lakes drain to the upper Salmon River which flows into the Snake River and ultimately the Columbia River. Redfish Lake is located approximately 900 river miles from the Pacific Ocean.

#### *3.2.4.b Life History*

Sockeye salmon are the second most abundant of the seven Pacific salmon species (Quinn 2005). They display more life history diversity than all other members of the Oncorhynchus genus (Burgner 1991). Sockeye salmon are generally anadromous, but distinct populations of non-anadromous O. nerka also exist; these fish are commonly referred to as kokanee (O. *nerka kennerlyi*). The majority of sockeye populations spawn in or near lakes. Spawning can take place in lake tributaries, lake outlets, rivers between lakes, and on lake shorelines or beaches where suitable upwelling or intra-gravel flow is present. Sockeye fry that are spawned in lake tributaries typically exhibit a behavior of rapid downstream migration to the nursery lake after emergence, whereas lake/beach spawned sockeye rapidly migrate to open limnetic waters after emergence. Lake-rearing juveniles typically spend one to three years in their nursery lake before emigrating to the marine environment (Gustafson et al., 1997). Other life history variants include ocean-type and river-type sockeye. Ocean-type populations typically use large rivers and side channels or spring-fed tributary systems for spawning and emigrate to sea soon after emergence. River-type sockeye rear in rivers for one year before emigrating to sea. Quinn (2005) describes the differences between ocean-type and river-type sockeye as a continuum of rearing patterns rather than as two discrete types.

Upon smoltification, sockeye emigrate to the ocean. Peak emigration occurs in mid-April to early May in southern sockeye populations (generally south of 52ºN latitude) and as late as early July in northern populations (62ºN latitude and north) (Burgner, 1991). Typically, river-type sockeye populations make little use of estuaries during their emigration to the marine environment (Quinn, 2005). Estuarine habitats may be more extensively used by ocean-type sockeye (Quinn, 2005). Upon entering marine waters, sockeye may reside in the nearshore or coastal environment for several months but are typically distributed offshore by fall (Burgner, 1991).

In Snake River system, sockeye salmon adults enter the Columbia River primarily during June and July and arrive in the Sawtooth Valley, peaking in August. The Sawtooth Valley supports the only remaining run of Snake River sockeye salmon. The adults spawn in lakeshore gravels, primarily in October (Bjornn et al., 1968). Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in gravels for three to five weeks, emerge from April through May and move immediately into lakes. Once there, juveniles feed on plankton for one to three years before they migrate to the ocean, leaving their natal lake in the spring from late April through May (Bjornn et al., 1968). Out-migrating juveniles pass Lower Granite Dam (the first dam on the Snake River downstream from the Salmon River) from late April to July, with peak passage from May to late June. Once in the ocean, the smolts remain inshore or within the Columbia River influence during the early summer months. Later, they migrate through the northeast Pacific Ocean (Hart, 1973, Burgner, 1991). SR sockeye salmon usually spend 2 to 3 years in the Pacific Ocean and return in their fourth or fifth year of life.

### *3.2.4.c Stressors and Threats*

After eight hydropower dams on the Columbia and Snake Rivers were finished in the 1970s, Snake River sockeye spawning runs declined dramatically. Natural reproduction of sockeye salmon has been impacted by pollution, habitat loss and degradation, overfishing, and loss of spawning and rearing areas (Good et al., 2005).

Sockeye spawning and rearing habitat quality in tributaries of the Snake River varies from excellent in wilderness areas to poor in areas of intensive human land uses (NMFS, 2016a). Critical habitat throughout much of the Interior Columbia (which includes the Snake River) has been degraded by intensive agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer streamflows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in non-wilderness areas. Human land use practices throughout the basin have caused streams to become straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations.

In many stream reaches designated as critical habitat in the Snake River basin, streamflows are substantially reduced by water diversions (NMFS, 2015b). Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence et al. 1996). Many stream reaches designated as critical habitat in the Snake River basin are on the Clean Water Act 303(d) list for impaired water quality (IDEQ, 2016).

Migration habitat quality for Snake River salmon has also been severely degraded, primarily by the development and operation of dams and reservoirs on the mainstem Columbia and Snake Rivers (NMFS, 2008). Hydroelectric development has modified natural flow regimes in the migration corridor causing higher water temperatures and changes in fish community structure that have led to increased rates of piscivorous and avian predation on juvenile salmon, and delayed migration for both adult and juveniles. Keefer et al. (2008b) also examined current run timing of SR sockeye salmon versus records from the early 1960s and concluded that an apparent shift to earlier run timing recently may reflect increased mortalities for later migrating adults. Physical features of dams such as turbines also kill migrating fish.

### *3.2.4.d Population Trend and Risk*

This species was once found in the many lakes of the Payette, Salmon and Wallowa River systems in Idaho and Oregon (USACE, 2002). Numbers have declined precipitously over the past century and the species was reduced to a remnant population close to extinction by the late 1980s and early 1990s. SR sockeye salmon returns to Redfish Lake since at least 1985, when the Idaho Department of Fish and Game (IDFG) began operating a temporary weir below the lake, have been extremely small (1 to 29 adults counted per year). NMFS proposed an interim recovery level of 2,000 adult SR sockeye salmon in Redfish Lake and two other lakes in the Snake River Basin (NMFS, 1995). Because only 16 wild and 264 hatchery-produced adult sockeye returned to the Stanley River Basin between 1990 and 2000, NMFS considers the risk of extinction of this ESU to be very high. In 2002, 52 adult sockeye salmon were counted at Lower Granite Dam (FPC, 2003).

Since 1991, a captive broodstock program has been part of the Snake River sockeye salmon recovery strategy (USACE, 2002). The short-term objective of the program is to prevent the extinction of the species, while the longer-term goal is acceleration of the re-establishment of sockeye salmon runs to waters of the Stanley Basin. This program cultures progeny that supplement the wild population (USACE, 2002). Since 1997, nearly 400 hatchery-origin anadromous sockeye adults have returned to the Stanley Basin from juveniles released by the program (NMFS, 2005a). In 1998, approximately 160,000 sub-yearling parr (presmolts) and smolts were released to lakes in the Stanley Basin. These salmon were raised at the Stanley Idaho Fish and Game aquaculture facility, which discharges to the Salmon River upstream of Redfish Lake. The captive broodstock program presently consists of several hundred fish of different year classes maintained at facilities in Eagle (Idaho) and Manchester (Washington).

NMFS 2015 states that "…Although the captive brood program has been successful in providing substantial numbers of hatchery produced O. nerka for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to re-establish sustainable natural production (Hebdon et al., 2004; Keefer et al., 2008b). Overall, although the risk status of Snake River sockeye salmon appeared to improve between 2005 and 2011, we determined, in our 2011 5-year review, that this ESU should retain its "endangered" classification."

### *3.2.4.e Critical Habitat*

Critical habitat for Snake River sockeye salmon was designated in 1993 and includes the Columbia, Snake and Salmon Rivers, Alturas Lake Creek, Valley Creek, Stanley Lake, Redfish Lake, Yellowbelly Lake, Pettit Lake, Alturas Lake, and all inlet/outlet creeks to these lakes (58 FR 68543). Watersheds containing spawning and rearing habitat for this ESU comprise approximately 510 square miles in Idaho. The watersheds lie partially or wholly within the counties of Blaine and Custer. Snake River sockeye salmon PBFs are compiled in Table 3.4.

### *3.2.4.f Use of the Action Area*

The Action Area is within the migration corridor used by Snake River Sockeye salmon adult and smolt life history forms. Returning adult sockeye salmon migrate upstream pass Lower Granite Dam in the Summer/fall with most passing upstream prior to September (Figure 3.10). Smolts migrate downstream through the area from March through mid-November.

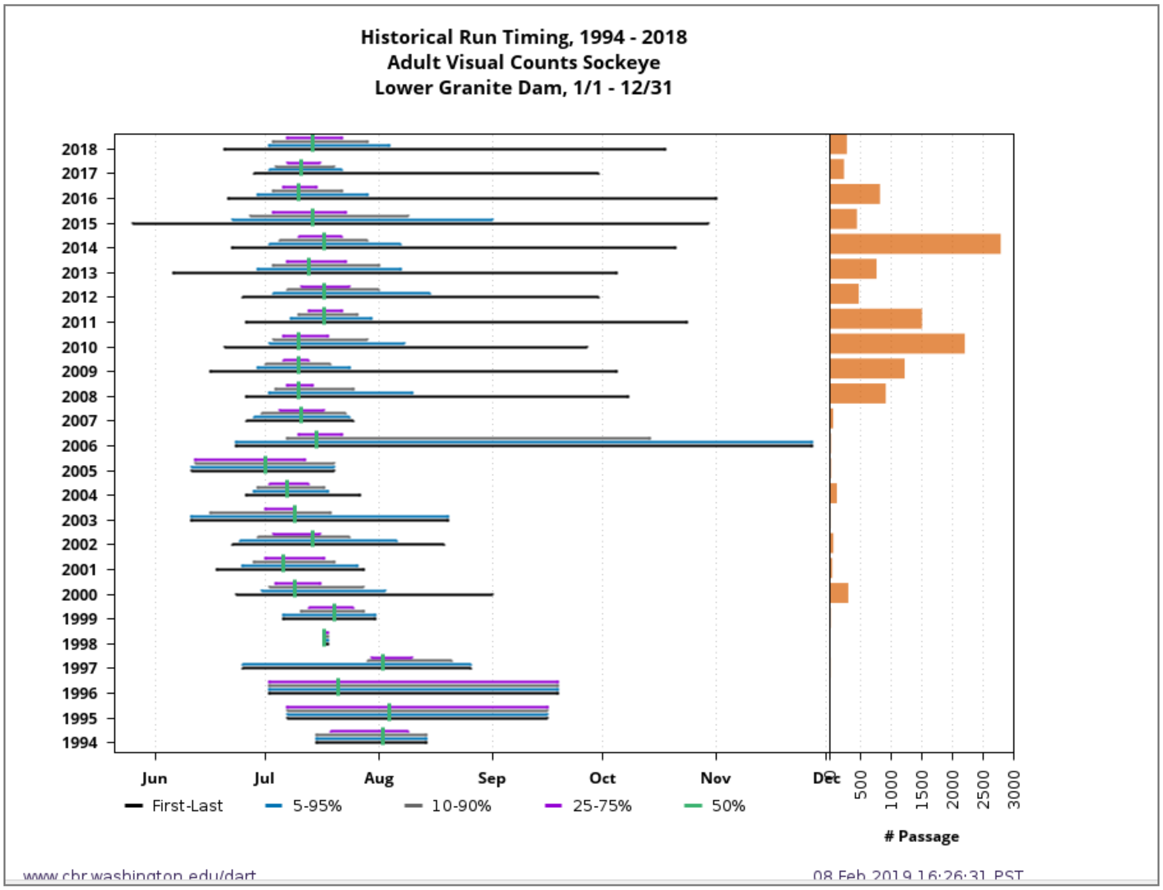


***Figure 3.10. Abundance and timing of Snake River sockeye salmon passing Lower Granite Dam 1994-2018 (Source: University of Washington DART database. Accessed 2/8/19).***

The Action Area encompasses the confluence of the Snake and Clearwater Rivers where the cold waters of the Clearwater flow into the warmer waters of the Snake River. As for other salmonid species, this area may be thermal refuge to migrating smolts and adults (NMFS, 2003). Some of these migrating fish may remain in this refuge for a few hours or days before continuing their migration.

#### *3.2.4.f.1 Timing and Abundance Data*

Based on travel time estimates between Columbia River dams developed by Quinn et al. (1996), it is estimated that sockeye would take less than two days to travel from lower Granite Dam to the confluence of the Snake and Clearwater rivers (based on the slowest calculated travel rate of 16.9 mi/day). Therefore, the fish data collected at the dam can be used to estimate run timing as well as fish abundance in the Action Area.

Dam passage data were obtained through University of Washington's Columbia Basin Research DART website. Sockeye passage data at the Lower Granite Dam are summarized for 2006 to 2015 based on daily count data (Figure 3.11). This time period includes a low flow year (2015), an average flow year (2014), and a high flow year (2011).

Very few adult sockeye were observed passing Lower Granite Dam during the 2006 through 2015 time period with the run size ranging from 1 to 339 during the migration period. First passage of adult sockeye across the dam into the Lower Granite Reservoir downstream of the mouth of the Clearwater River ranged from June 22, 2009, to June 30, 2008 (Table 3.15). The date of last adult passage for the Lower Granite Dam ranged from July 31, 2010, to October 21, 2014.

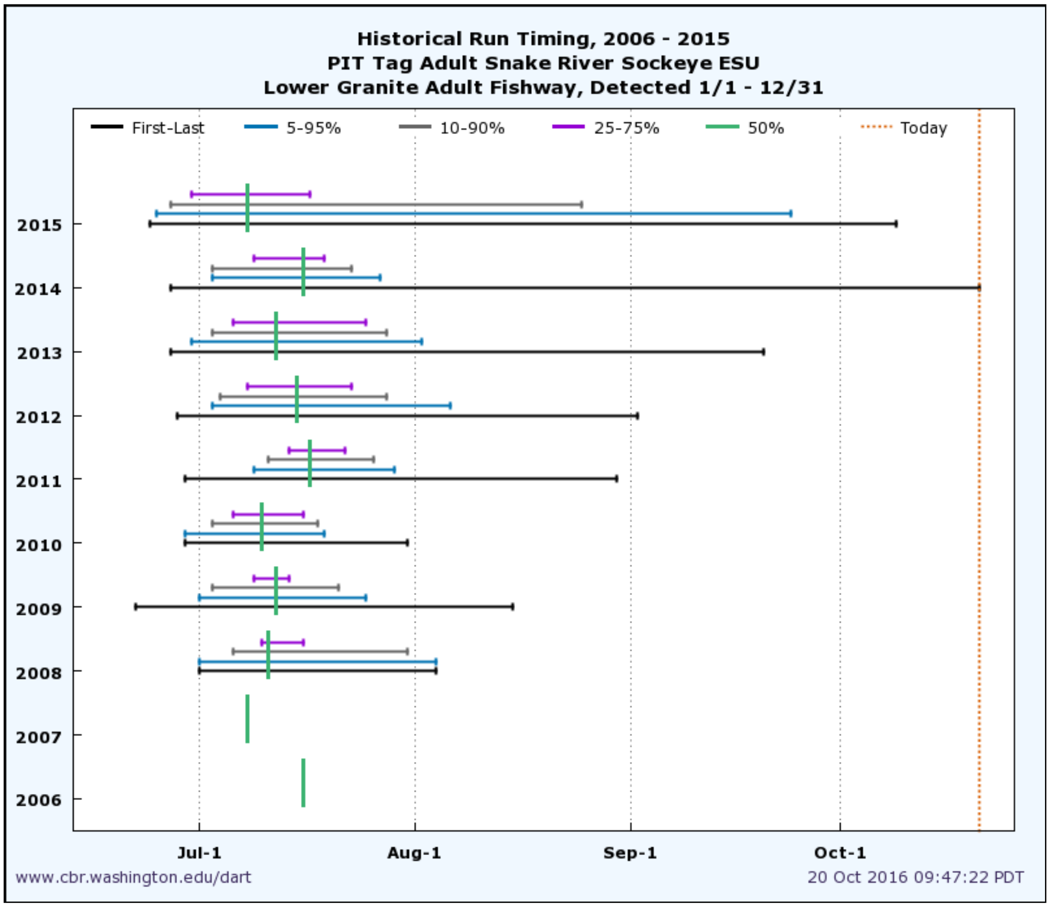


***Figure 3.11. Average adult sockeye passage at Lower Granite Adult Fishway, 2006 - 2015 (Source: DART).***

***Table 3.15. Dates of adult sockeye passage at Lower Granite Adult Fishway, 2008 - 2016 (Source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2008 | Average | 6/30 | 6/30 | 7/10 | 8/3 | 8/3 |
| 2009 | Average | 6/22 | 7/1 | 7/12 | 7/25 | 8/15 |
| 2010 | Average | 6/29 | 6/29 | 7/10 | 7/19 | 7/31 |
| 2011 | High | 6/29 | 7/9 | 7/17 | 7/29 | 8/30 |
| 2012 | Average | 6/27 | 7/2 | 7/14 | 8/5 | 9/1 |
| 2013 | Average | 6/27 | 6/30 | 7/12 | 8/2 | 9/20 |
| 2014 | Average | 6/27 | 7/3 | 7/16 | 7/27 | 10/21 |
| 2015 | Low | 6/24 | 6/25 | 7/8 | 9/24 | 10/9 |

Downstream migrating juvenile wild sockeye passed over the Lower Granite Dam primarily between April and early June from 2006 to 2015, with a small proportion of late outmigrants passing the dam into November (Table 3.16). The dates of first juvenile sockeye passage through Lower Granite Dam ranged from April 25, 2012, through May 16, 2010. The dates of last juvenile sockeye passage through Lower Granite Dam ranged from July 3, 2014, through November 30, 2009.

***Table 3.16. Dates of juvenile sockeye passage at Lower Granite Dam, 2006 - 2016 (Source: DART).***

| Year | Flow | First | 5th percentile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 5/6 | 5/10 | 5/17 | 6//1 | 11/15 |
| 2007 | Average | 4/30 | 5/5 | 5/16 | 5/27 | 10/20 |
| 2008 | Average | 5/13 | 5/17 | 5/24 | 6/14 | 7/4 |
| 2009 | Average | 5/8 | 5/15 | 5/19 | 5/28 | 11/30 |
| 2010 | Average | 5/16 | 5/17 | 5/22 | 6/2 | 6/22 |
| 2011 | High | 5/13 | 5/19 | 5/23 | 6/2 | 7/28 |
| 2012 | Average | 4/25 | 5/17 | 5/20 | 5/31 | 8/1 |
| 2013 | Average | 5/4 | 5/14 | 5/16 | 5/19 | 7/23 |
| 2014 | Average | 5/8 | 5/16 | 5/17 | 5/23 | 7/3 |
| 2015 | Low | 4/28 | 5/9 | 5/16 | 5/19 | 5/31 |

Juvenile hatchery sockeye, from the captive broodstock program have been counted at Lower Granite Dam and Lower Monumental Dam since 1995. Dates of migration through the Snake River for hatchery-reared sockeye were comparable to those for wild sockeye.

#### *3.2.4.f.2 Travel Time*

Bjornn et al. (2000) studied adult sockeye migration speed, with speeds ranged from 29 km/day to 43.8 km/day, with a mean of 25.6 km/day. This distance from the confluence of the Snake and Clearwater rivers and the Lower Granite Dam is approximately 31 miles, or 50 km. Given the mean migration speeds observed in the literature, sockeye may require two to two and one-half days to travel between the confluence of the Snake and Clearwater Rivers and the Lower Granite Dam.

### 3.2.5 Steelhead (Threatened)

The Snake River Basin (SRB) steelhead was listed as a threatened ESU on August 18, 1997 (62 FR 43937), with a revised listing as a DPS on January 5, 2006 (71 FR 834). In 2016, NMFS conducted a 5-year review of the status of the species and based on the best available scientific information determined that the "threatened" classification remained appropriate (NMFS 2016a; 81 FR 33468). This DPS includes all naturally spawning steelhead populations below natural and manmade impassable barriers in streams in the SRB. Six artificial propagation programs are considered part of the DPS: Tucannon River, Dworshak NFH, Lolo Creek, North Fork Clearwater, East Fork Salmon River, and the Little Sheep Creek/Imnaha River Hatchery steelhead hatchery programs. NMFS has determined that these artificially propagated stocks are no more divergent relative to the local natural population(s) than what would be expected between closely related natural populations within the DPS [71 FR 834]. The SRB steelhead listing does not include resident O. mykiss (rainbow trout) that co-occur with (migratory) steelhead. [62 FR 43937].

#### ***3.2.5.a Distribution***

Two major genetic groups or "subspecies" of steelhead occur on the west coast of the United States: a coastal group and an inland group, separated on the Fraser and Columbia River basins by the Cascade Crest. Historically, steelhead likely inhabited most coastal streams in Washington, Oregon, and California, as well as many inland streams in these states and in Idaho. However, during the [2]0th century, over 23 indigenous, naturally reproducing stocks of steelhead are believed to have been extirpated, and many more are thought to be in decline in numerous coastal and inland streams.

The Snake River Basin steelhead DPS occupies the SRB, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. The Snake River flows through terrain that is warmer and drier on an annual basis than the upper Columbia Basin or other drainages to the north. Geologically, the land forms are older and much more eroded than most other steelhead habitat. Collectively, the environmental factors of the Snake River Basin result in a river that is warmer and more turbid, with higher pH and alkalinity, than is found elsewhere in the range of inland steelhead.

This ESU comprises two groups, A-run and B-run, which are distinguished on the basis of migration timing, ocean residence duration, and adult size (NMFS, 1997). A-run steelhead generally have a one-year ocean residence time, while B-run fish have a two-year ocean residency. A-run steelhead were historically present in all Snake River drainages while B-run fish were found only in the Clearwater River and Salmon River drainages (USACE, 1995).

### *3.2.5.b Life History*

Steelhead exhibit a complex life cycle and may be either anadromous or freshwater resident. The anadromous form, called steelhead, is unlike other Pacific salmon species in that individuals can spawn multiple times before dying (a trait known as iteroparity). Both A-run and B-run steelhead in the Snake River Basin exhibit summer-run timing characterized by the timing at which they are entering rivers throughout the year. Summer A-run steelhead enter the Columbia River from June to early August, while B-run steelhead migrate later, from August to October (USACE, 2002). The Salmon River drainage contains primarily A-run steelhead, except for the South Fork and Middle Fork Salmon Rivers, which contain primarily naturally producing B-run steelhead. The Clearwater River drainage also contains A-run fish, except for the Selway River drainage which contains primarily naturally-producing B-run fish (Rich & Petrosky, 1994); (Busby et al., 1996).

As with Chinook, migrating steelhead make extensive use of cold-water areas (Keefer et al., 2018). Steelhead may spend prolonged periods in cold water areas (e.g. mouths of tributaries) because steelhead enter freshwater in pre-mature state and have a protracted period in freshwater before spawning. In the Snake River system, Keefer et al. (2008a) found wintering steelhead favor reservoirs near confluences with natal tributaries. Steelhead use these deep, low-velocity habitats as protection from predators and to limit energy expenditure. After holding over the winter in larger rivers in the SRB, steelhead disperse into smaller tributaries to access spawning habitat. Earlier dispersal occurs at lower elevations, and later dispersal occurs at higher elevations.

SRB steelhead spawn the following spring from March through May. A-run steelhead spawning a few weeks earlier and at lower elevations than B-run steelhead. Snake River steelhead spawn at higher elevations (up to 2,000 m) and migrate farther from the ocean (up to 1,500 km) than any other steelhead in the world (Busby et al., 1996). Although steelhead are iteroparous, they rarely spawn more than twice (Nickelson et al., 1992). Before most of the lower Columbia River and Snake River dams were constructed, the proportion of repeat-spawning steelhead in the Snake and Columbia rivers was less than five percent (USACE, 2002). The current proportion of repeat spawners is unknown but assumed to be near zero.

Snake River steelhead spawn in cool, clear tributaries of the river where water temperatures range from 10° to 15.5° C (Scott & Crossman, 1973). Preferred spawning habitat includes small and medium-sized gravel in riffles located upstream of pools. Depending on the water temperature, steelhead eggs may incubate in redds for up to four months before hatching. Fry emerge from the gravel from July through September.

Juvenile steelhead prefer water temperatures of 12° to 15° C and occupy shallow riffles for the first year of life before moving to pools and runs. Winter rearing occurs at lower densities and across a wide range of habitat types. Winter rearing habitat is characterized by complexity, primarily in the form of wood content and size. Older juveniles may move downstream to rear in larger tributaries and river main-stems (Nickelson et al., 1992). Young steelhead remain in freshwater for one to four years before migrating toward the ocean as steelhead smolts. Steelhead smolts, 15 to 20 cm in total length (Meehan and Bjornn, 1991), pass the Lower Granite Dam on their way to the ocean from mid-April through early July (USACE et al., 1999). A-run steelhead as mentioned above typically stay in the ocean for one year, while B-run steelhead stay for two years before returning to their natal rivers for spawning.

Hatchery fish are widespread and stray to spawn naturally throughout the region. In the 1990s, an average of 86 percent of adult steelhead passing Lower Granite Dam were of hatchery origin. Hatchery fish dominate some stocks, but do not contribute to others (Berryman et al., 2007).

#### *3.2.5.c Stressors and Threats*

Hydrosystem projects create substantial habitat blockages in this ESU; the major ones are the Hells Canyon Dam complex (mainstem Snake River) and Dworshak Dam (North Fork Clearwater River). Minor blockages to fish passage are common in tributaries throughout the region. These physical and environmental changes, combined with substantial hatchery effects and loss of native stock diversity, have resulted in complex shifts in steelhead migration timing and altered migration behaviors (Keefer et al. 2008a). As with the other salmon species, steelhead have been affected by various human activities that have contributed to their decline. Spawning and rearing areas have been degraded by human land management practices including overgrazing, historical gold dredging and other practices that increase sedimentation. Impacts of climate change are also considered factors for decline (i.e. prolonged drought conditions). As reviewed in NMFS 2011a; and NMFS 2011b, limiting factors include:

- Degradation of floodplain connectivity and function, channel structure and complexity, riparian areas and large woody debris recruitment, stream flow, and water quality
- Increased water temperature, which can affect thermoregulatory behavior and delay migration
- Harvest-related effects, particularly for B-run steelhead
- Predation
- Genetic diversity effects from out-of-population hatchery releases

#### *3.2.5.d Population Trend and Risk*

Snake River Basin steelhead formerly inhabited most of the major tributaries and streams of the Snake River and were limited only by natural barriers. Today, no naturally occurring steelhead are found above Hells Canyon Dam on the Snake River due to the lack of fish passage provisions at the dam. Historically, the basin supported large numbers of steelhead. NMFS and USFWS (1972) estimated that 114,000 steelhead were produced annually in the Snake River Basin from 1954 to 1967. Snake River Basin steelhead recently suffered severe declines in abundance relative to historical levels. The natural component for steelhead escapement above Lower Granite Dam was about 9,400 from 1990-1994. Low run sizes over the last 10 years are most pronounced for naturally produced (wild) steelhead. Based on surveys in the mid-1990s, approximately 86 percent of adult steelhead at the Lower Granite Dam are of hatchery origin (Busby et al., 1996).

Naturally produced fish make up only a small fraction of the total adult run of the Snake River steelhead ESU. Although several large production hatcheries exist throughout this ESU, relatively few data exist regarding the numbers and relative distribution of hatchery fish that spawn naturally, or the consequences of such spawning when they do occur. Significant increases in 2000 and 2001 in adult returns in some populations and evidence for high smolt-adult survival indicate that populations in this ESU are still capable of responding to favorable environmental conditions. Besides the recent increases, abundance in most populations for which there are adequate data are well below interim recovery targets.

For the entire SR steelhead ESU, NMFS (2000) estimates that the median population growth rate (lambda) over a base period from 1990 through 1998 ranges from 0.91 to 0.70, decreasing as the effectiveness of hatchery fish spawning in the wild increases compared with that of fish of wild origin (Tables B-2a and B-2b in McClure et al., 2000). The main producer of steelhead in the Columbia River Basin is the Snake River. In 2002, the turnoff into the Snake River was about 210,000, 71 percent of the total counted at McNary Dam (286,805). The 2002 Snake River steelhead count was about twice the 10-year average. The numbers of wild steelhead (nonclipped adipose fin) increased to a mean of 55,000 in the Snake River in 2002 (FPC, 2003).

The NMFS included the following summary in their 2004 *Biological Opinion for Consultation on Remand for Operation of the Columbia River Power System* (NMFS, 2004b): “The lack of information on adult spawning escapement to many tributary production areas makes it difficult to quantitatively assess the viability of the SR steelhead ESU. Estimates of annual returns are limited to estimates of aggregate numbers over Lower Granite Dam and spawner estimates for the Tucannon, Grande Ronde, and Imnaha rivers. In their preliminary report, Fisher and Hinrichsen (2004) estimated that the geometric mean of the natural-origin run was 37,784 during 2001-2003, a 253% increase over the 1996-2000 period (10,694 steelhead). The slope of the population trend increased 9.3% (from 1.00 to 1.10) when the counts for 2001-2003 were added to the 1990-2000 data series. These data indicate that, at least in the short term, the natural-origin run has been increasing.”

NMFS states in the 2015 *Biological Opinion on USEPA’s Action on Oregon WQS* (NMFS, 2015) that the status of most populations in this DPS remains highly uncertain. Population-level natural origin abundance and productivity inferred from aggregate data and juvenile indices indicate that many populations are below the minimum combinations defined by the NMFS’ Interior Columbia Technical Recovery Team viability criteria.

#### *3.2.5.e Critical Habitat*

Critical habitat was designated by the NMFS on September 2, 2005 (70 FR 52630). Critical habitat for the steelhead consists of river reaches of the Columbia, Snake, and Salmon Rivers, and all tributaries of the Snake and Salmon River presently or historically accessible to Snake River steelhead (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dam). This designation includes including Clearwater, Grande Ronde, Selway and Tucannon Rivers. PBFs for the Snake River Basin DPS of steelhead are compiled in Table 3.4.

### *3.2.5.f Use of the Action Area*

The Action Area is within the migration corridor used by Snake River steelhead adult and juveniles. Steelhead of the Snake River DPS are considered summer-run steelhead due to their adult migration pattern. In the Snake River, most passing Lower Granite Dam in mid-September through late October (Figure 3.12 and Figure 3.13). Adult steelhead may feed and rest in the confluence of the Snake and Clearwater rivers prior to moving farther upstream in each river for spawning in the spring. In a tagging study conducted from 1969 to 1971 in the confluence area, adult steelhead were found to migrate and rest in near shore areas, traveling 20 to 30 m out into the channel and migrating in mid-channel only when crossing to the other shore (USEPA, 1974).

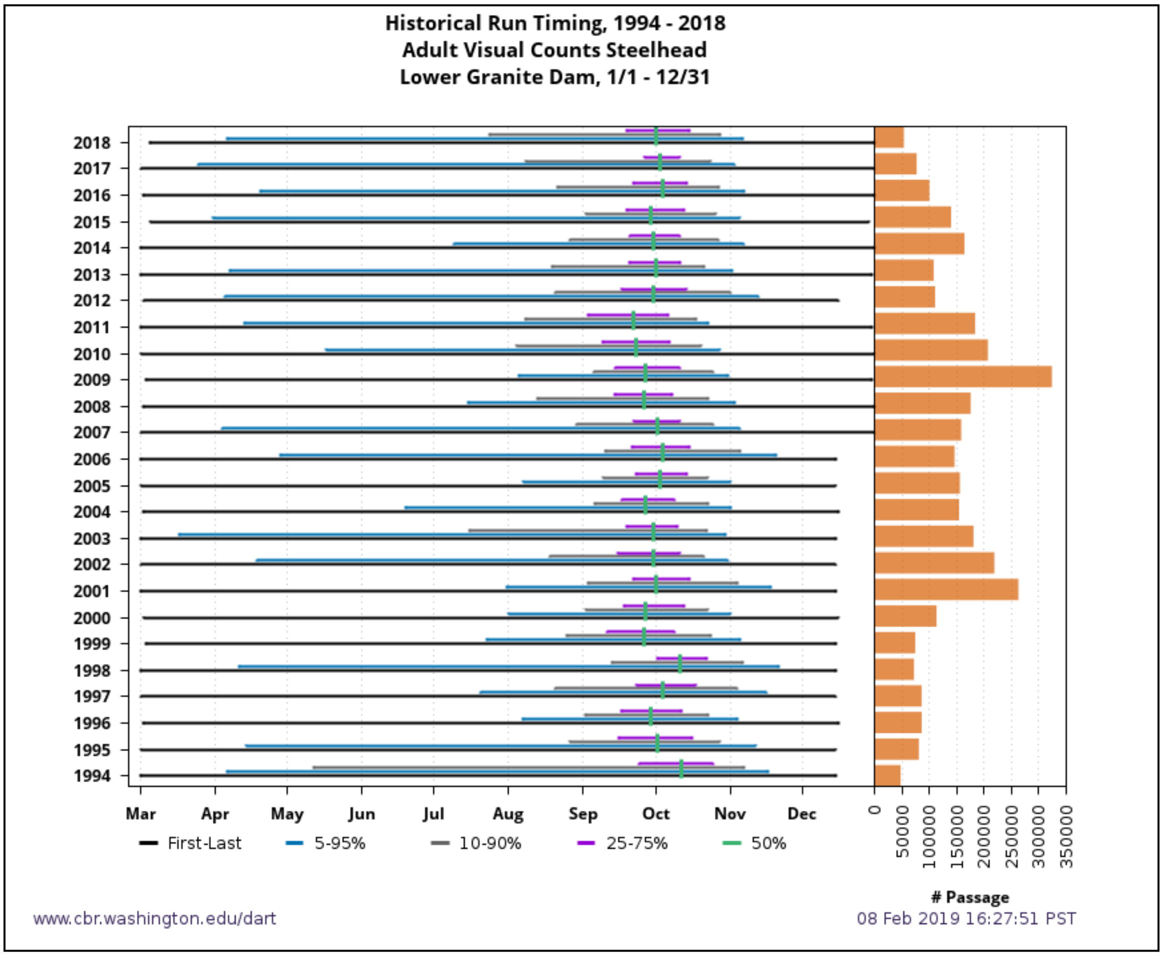


***Figure 3.12. Abundance and timing of Snake River steelhead passing Lower Granite Dam 1994-2018 (Source: University of Washington DART database. Accessed 2/8/19).***

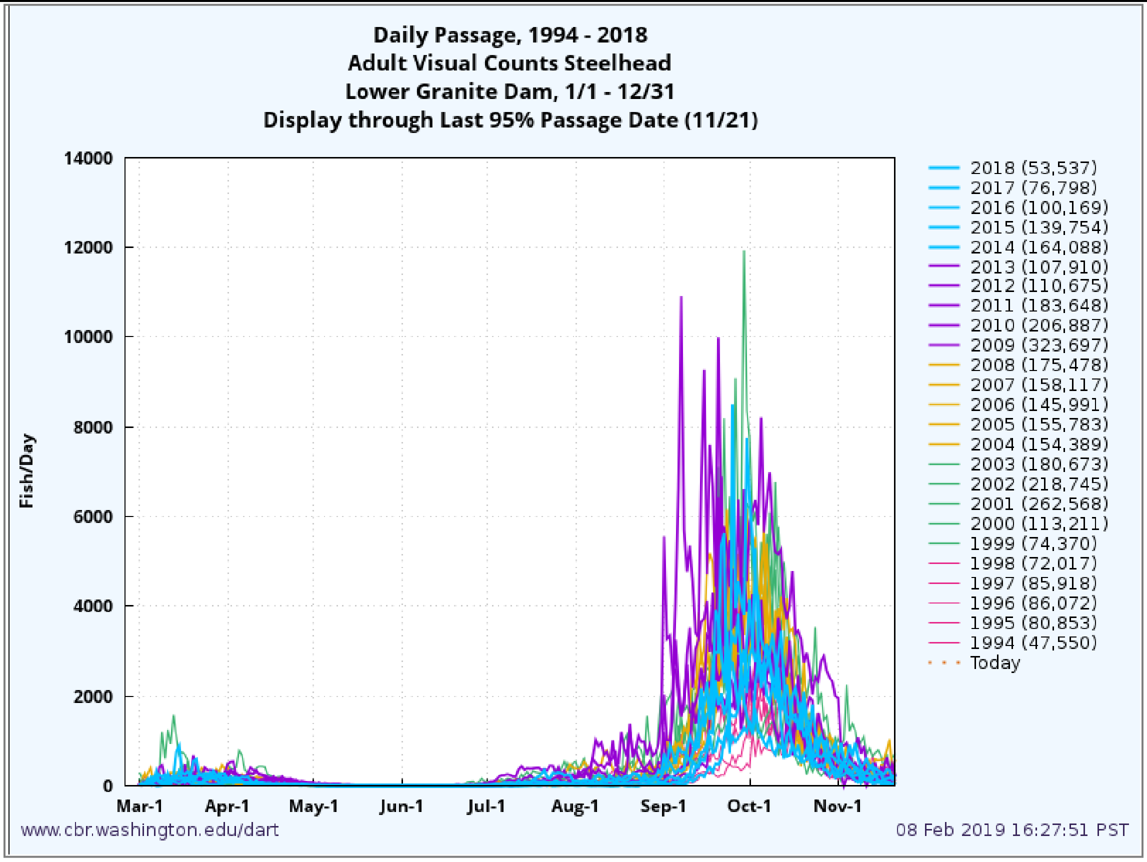


***Figure 3.13. Adult steelhead passage counts at Lower Granite dam by year (Source: University of Washington DART data base. Accessed February 8th, 2019).***

Telemetry studies indicate that adult steelhead typically occur in the vicinity of the Snake/Clearwater confluence for about 4-5 months annually. Bjornn et al. (2003) used telemetry studies from 1991-1995 to study the migration of adult steelhead past dams and through reservoirs in the lower Snake River and into the tributaries. They observed that many adult steelhead entered the Clearwater River in the fall, but large numbers of steelhead destined for the Clearwater River over-wintered in Lower Granite Reservoir, near the confluence of the Snake and Clearwater Rivers and in the Snake River between Lewiston, ID, and Asotin, WA. For the four-year period, they identified over-wintering reaches for 327 of 491steelhead where a last telemetry record was in the Clearwater River. Of the 327, 70.3 percent over-wintered upstream of Lower Granite Dam and the remainder over-wintered downstream from the dam. The over-wintering locations were subdivided for 245 of the 327 steelhead:  48.6 percent over-wintered in the Lower Granite Reservoir and Clearwater/Snake River confluence area upstream to the Snake River receiver site located near Asotin WA (RKM 233.8), and the lower Clearwater receiver site located upstream of the Potlatch Mill (RKM 231.7). A more recent tagging study by Keefer et al. (2008a) found that the LGDP is used extensively by adult wintering Clearwater River steelhead (to a lesser extent by other Snake River populations).

Typically, redds are built in smaller tributaries and in main river reaches above a confluence area. However, a small number of A-run steelhead spawn in Snake River tributaries that enter LGDP and downstream of the Lower Granite Dam (USACE, 1995). Juvenile steelhead may use the confluence area of the Snake and Clearwater Rivers and LGDP for rearing habitat, although most smolts migrate rapidly through the area.

Orientation within the water column of the Action Area is not specifically known for adult steelhead. However, hydroacoustic surveys (USACE, 1991) found larger fish are typically oriented in close proximity to the bottom in the Lower Granite Reservoir. Yearling steelhead have been collected at mid (6-12 m) and shallow (< 6m) depth (Bennett et al., 1993) as well as depths >18m (USACE, 1991). Hydroacoustic surveys conducted in May and June found out-migrating juvenile salmonids were located throughout the water column, with the greatest concentration in the upper 15 m (USACE, 1991). Given the potential distribution of the various life-stages of steelhead, important habitats within the Action Area are those that provide cooler water or eddies for resting, and include gravel bars, depressions, channel bends, particularly near the Snake River/Clearwater River confluence.

*3.2.5.f.1 Timing and Abundance Data*

Most upstream migration of wild adult steelhead across the dam into the LGDP downstream of the mouth of the Clearwater River occurred from April to December (Figure 3.12). As shown in Table 3.17, the date of early passage adult steelhead at the Lower Granite Dam, 1993 through 1999, ranges from January 2, 2006 to March 4, 2007. The date of late passage ranges from December 15 in 2006 and 2012 to December 31, 2010. A-run migration in this portion of the Snake River occurs between March and May, followed by B-run migration between August and November.

Data from 20–6 - 2015 shows downstream migrating juvenile wild steelhead passed over the Lower Granite Dam primarily between April and mid-May, with a small proportion of late outmigrants passing the dam in late July and early August. First passage dates ranging from March 18, 2006, through April 2, 2010 (Table 3.18). Dates of last passage over Lower Granite Dam ranged from June 23, 2007, through December 16, 2012. These dates probably represent the dates of sampling rather than the actual dates of passage. Hatchery adult and juvenile steelhead make up most of the steelhead population in the Snake River. Dates of migration through the Snake River for hatchery-reared steelhead were comparable to those for wild steelhead.

***Table 3.17. Dates of adult steelhead passage at Lower Granite Adult Fishway, 2006 - 2015 (source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 1/2 | 3/25 | 9/27 | 11/4 | 12/15 |
| 2007 | Average | 3/4 | 7/8 | 9/24 | 11/3 | 12/17 |
| 2008 | Average | 2/22 | 3/27 | 9/20 | 10/31 | 12/12 |
| 2009 | Average | 3/3 | 8/23 | 9/24 | 11/1 | 12/28 |
| 2010 | Average | 2/4 | 4/2 | 9/23 | 10/29 | 12/31 |
| 2011 | High | 2/16 | 4/2 | 9/17 | 10/24 | 12/30 |
| 2012 | Average | 2/17 | 3/31 | 9/28 | 11/6 | 12/15 |
| 2013 | Average | 2/27 | 3/28 | 10/8 | 11/7 | 12/13 |
| 2014 | Average | 1/2 | 1/2 | 9/27 | 11/1 | 12/30 |
| 2015 | Low | 1/1 | 3/31 | 9/29 | 11/7 | 12/31 |

***Table 3.18. Dates of juvenile steelhead passage at Lower Granite Dam, 2006 - 2015 (source: DART).***

| Year | Flow | First | 5th %tile | 50th %tile | 95th %tile | Last |
|---|---|---|---|---|---|---|
| 2006 | Average | 3/28 | 4/12 | 5/2 | 5/22 | 6/25 |
| 2007 | Average | 3/25 | 4/22 | 5/8 | 5/24 | 6/23 |
| 2008 | Average | 4/5 | 4/21 | 5/9 | 5/26 | 11/21 |
| 2009 | Average | 3/25 | 4/19 | 4/26 | 5/21 | 7/19 |
| 2010 | Average | 4/2 | 4/24 | 5/7 | 6/4 | 7/8 |
| 2011 | High | 3/23 | 4/2 | 5/10 | 5/31 | 10/6 |
| 2012 | Average | 3/22 | 4/14 | 4/29 | 5/24 | 12/16 |
| 2013 | Average | 3/20 | 4/14 | 5/11 | 5/22 | 10/19 |
| 2014 | Average | 3/20 | 4/19 | 5/7 | 5/27 | 10/31 |
| 2015 | Low | 3/18 | 4/12 | 5/5 | 5/29 | 8/20 |

### *3.2.5.f.2 Travel Time*

Keefer et al. (2002) investigated adult steelhead travel time and passage efficiency in the lower Columbia and Snake rivers using radio telemetry. Migration speeds ranged from 24 km/day to 42.5 km/day, with a mean migration speed of 32.8 km/day. Keefer et al. (2003) measured migration speed of adult steelhead at eight main-stem dams and reservoirs in the lower Columbia and Snake rivers, all major tributaries between

Bonneville and Priest Rapids dams on the Columbia River and the Snake River and its tributaries upstream to Hells Canyon Dam during warmer months (June-October) over a period of four years. Median values for adult steelhead reported for the four-year duration ranged from 7 km/day to 21 km/day, with a mean of 13.1 km/day. Keefer et al. (2003) also studied adult steelhead migration speed in Columbia and Snake River reservoirs (Bonneville, Dalles, John Day, McNary to Ice harbor, McNary to Hanford receiver, Ice Harbor, Lower Monumental, Little Goose, Lower Granite to Snake River receiver, and Lower Granite to Columbia River receiver) over the same four-year duration. Median values reported for the four-year duration ranged from 10 km/day to 49 km/day, with a mean of 29.5 km/day. In a study conducted by Bjornn et al. (2003), adult steelhead migration speeds ranged from essentially zero to 150.6 km/day, with a mean of 15.6 km/day.

A range of mean migrations speeds for adult steelhead of approximately 13 to 33 km/day has been observed. This distance from the confluence of the Snake and Clearwater rivers and the Lower Granite Dam is approximately 31 miles, or 50 km. Given the mean migration speeds observed in the literature, adult steelhead may require one and one half to four days to travel between the Lower Granite Dam and the confluence.

Travel times of wild steelhead juveniles were estimated from the PTAGIS database by NMFS (2003). Juveniles trapped and tagged at a Snake River and a Clearwater River trap from 1990-2003 were detected at the Lower Granite Dam allowing for estimates of travel time. The size range for sampled juvenile steelhead was 80-340 mm at the Snake River trap and 120-270 mm at the Clearwater trap. This analysis has two caveats: 1) fish samples were collected from the surface, where juveniles that are actively migrating are most likely to be oriented in the water column. This may bias the sample away from the portions of the cohort that may be feeding/rearing as they progress downstream; and 2) data were collected during the peak migration, again focusing the study on one portion of the entire cohort.

The following travel times were estimated in days for steelhead juveniles:

***Table 3.19. Travel Times for Steelhead Juveniles***

| **Snake River Trap (n=13887)** | | **Clearwater River Trap (n=4447)** | |
|---|---|---|---|
| Mean | 3.7 | Mean | 5.6 |
| Median | 3.0 | Median | 4.9 |
| 99.5 percentile | 20.2 | 99.5 percentile | 20.1 |

### 3.2.6 Bull Trout (Threatened)

The USFWS listed the Columbia River DPS of the bull trout population as threatened on June 10, 1998 (USFWS, 1998c). Threatened status was reaffirmed on November 1, 1999 (USFWS, 1999). On September 26, 2005 the USFWS promulgated a final rule designating critical habitat for the Columbia River DPS of bull trout (USFWS, 2005). As determined by the USFWS, bull trout critical habitat includes the Clearwater River Basin Unit (Unit 15) (USFWS, 2005). The Unit extends from the confluence of the Snake River at Lewiston to the headwaters of the Clearwater River within the Bitterroot Mountains (USFWS, 2005). Designated critical habitat is present in the Action Area.

### *3.2.6.a Distribution*

Bull trout range from Puget Sound throughout the Columbia River and Snake River basins, extending east to headwater streams in Montana and Idaho, and into Canada. Bull trout occur in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers within the Columbia River Basin in Idaho, Oregon, Washington, and Montana; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana. The Columbia River population segment comprises 386 bull trout populations in Idaho, Montana, Oregon, and Washington, with additional populations in British Columbia. The Columbia River population segment includes the entire Columbia River Basin and all its tributaries, excluding the isolated bull trout populations found in the Jarbridge River in Nevada (USFWS 1998; USFWS 1999).

### *3.2.6.b Life History*

In Idaho, bull trout exhibit both migratory and resident life history types (USACE et al., 1999). Migratory bull trout spawn in tributary streams and juveniles rear in that stream for one to four years before migrating to either a larger river (fluvial life history forms) or to a lake (adfluvial life history forms) where they will spend their adult life. They return to their natal tributary streams to spawn (Fraley & Shepard, 1989). Migration corridors are important for sustaining bull trout populations, allowing for gene flow and connecting wintering areas to summer/foraging habitat (Rieman & McIntyre, 1993). Migratory bull trout occur in areas where conditions allow for movement from upper watershed spawning streams to larger downstream waters with greater foraging opportunities (Dunham & Rieman, 1999). Resident bull trout complete their entire life cycle in a single stream. Both resident and migratory forms may occur together in the same stock, and either form can produce resident or migratory offspring (Rieman & McIntyre, 1993).

Adult bull trout migrate from feeding to spawning grounds during the spring and summer (USFWS, 1999). Spawning occurs from August to November, and peaks during September and October (Idaho State, 1996). Bull trout spawning occurs in cold stream reaches within river basins that are clean and free of sediment (USACE et al., 1999). In fact, water temperatures of 10º C or less typically induce spawning (Idaho State, 1996; USFWS, 1999). Spawning sites are typically found in runs, tails and pools with water depth ranging from 0.2 to 0.8 m. Eggs are buried 10 to 20 cm in the gravel with a water velocity ranging from 0.2 to 0.6 m/s (Idaho State, 1996). Bull trout embryos incubate over the winter and hatch in late winter or early spring (Weaver & White, 1985). Emergence has been observed over a relatively short period of time after a peak in stream discharge from early April through May (Rieman & McIntyre, 1993).

Juvenile migratory bull trout typically remain in tributary streams for one to three years and grow to six to eight inches before migrating to river mainstems and lakes. Juvenile bull trout spend most of their time in close proximity to stream substrate (USFWS, 1998a). They require high levels of in-channel woody debris, undercut banks and rock/cobble substrate for use as cover (Rieman & McIntyre, 1993; Idaho State, 1996; USFWS, 1999). While all bull trout are sensitive to temperature and Rieman and McIntyre (1993) report that temperatures greater than 15° C limit bull trout distribution, juvenile bull trout are more sensitive to temperature changes than other life stages. Hillman and Essig (1998) found that the optimal temperature for juvenile growth and rearing is likely 12 º to 14º C. Juvenile bull trout prey on terrestrial and aquatic insects but become piscivorous as they mature (USFWS, 1998b). They migrate during the spring, summer and fall. Once reaching the river mainstem or lake, they will remain there until reaching sexual maturity, which is from four to seven years of age (USFWS, 1998b). Migratory bull trout are typically larger than the resident forms due to the increased productivity of larger streams and lakes, and they can reach lengths of 24 inches. Resident fish are commonly six to twelve inches as adults (USFWS, 1998c).

Mature bull trout associated with reclamation projects in the upper region of the Snake River basin appear to reside in reservoirs for approximately six months between November and June (USACE et al., 1999). During this period, with water temperatures of 7° to 12° C, adult adfluvial bull trout live in shallow areas (Flatter, 1997). Most bull trout, even those not sexually mature, appear to migrate upstream beginning in May and June, and return to reservoirs in November or December (USACE et al., 1999).

All life history stages of bull trout have complex habitat requirements compared to many other salmonids (Fraley & Shepard, 1989; Rieman & McIntyre, 1993). The five physical parameters necessary for bull trout success, as outlined by Rieman and McIntyre (1993), are adequate channel and hydrologic stability, substrate, cover, water temperature, and the presence of migration corridors.

Appropriate spawning and rearing substrate is also necessary. Stream flow, bed load movement and channel instability have been found to influence the survival of juvenile bull trout (Weaver, 1985; Goetz, 1989). Preferred spawning habitat of bull trout includes low gradient streams with loose, clean gravel and cobble substrate and high water quality (Fraley & Shepard, 1989; USFWS, 1998a). Their relatively long incubation period makes bull trout eggs and embryos vulnerable to fine sediment accumulation and water quality degradation (Fraley & Shepard, 1989). Cover such as large woody debris, undercut banks, boulders, pools, side margins, and beaver ponds is heavily utilized by all life stages of bull trout for foraging and resting habitat (USFWS, 1998c).

#### *3.2.6.c Stressors and Threats*

Bull trout are vulnerable to many of the same threats that have reduced salmon populations. Throughout their range, bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, entrainment in diversion channels, and introduced non-native species (64 FR 58910).

Within the Clearwater Unit, numerous threats to bull trout have been identified, including habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, angler harvest and associated hooking mortality, poaching, entrainment, nonnative species, operation and maintenance of dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (USFWS, 2002a).

Because of their need for very cold waters and long incubation time, bull trout are sensitive to the land management activities that have resulted in increased water temperatures, reduced water quality, and degraded stream habitat, especially along larger river systems and streams located in valley bottoms. Degraded conditions have severely reduced or eliminated migratory bull trout as water temperature, stream flow, and other water quality parameters fall below the range of conditions that these fish can tolerate. Furthermore, dams and other instream structures affect bull trout by blocking migration routes, altering water temperatures, and contributing to increased mortality rates due to the potential to be trapped in irrigation and other diversion structures (USFWS, 2002a). Bull trout are especially vulnerable to the impacts of climate change given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al., 2007; Rieman et al., 2007). Additional anthropogenic threats to bull trout include industrial development and urbanization, timber harvest, and poaching or bycatch.

Brook trout, introduced throughout much of the range of bull trout, easily hybridize with bull trout, producing sterile offspring. Brook trout also reproduce earlier and at a higher rate than bull trout, so bull trout populations are often supplanted by these nonnatives. Also, competition with non-native brown trout, lake trout, and brook trout can be detrimental to bull trout populations

#### *3.2.6.d Population Trend and Risk*

Bull trout populations within the Columbia River population segment have declined from historic levels and are generally considered to be isolated and remnant. In Idaho, bull trout were historically found in the major tributaries in the Columbia and Snake Rivers. Currently, most bull trout populations are confined to headwater areas of tributaries to the Columbia, Snake, and Klamath rivers. While bull trout occur over a large area, their distribution has contracted, and abundance has declined. Several local extinctions have been documented. Many of the remaining populations are small and isolated from each other, making them more susceptible to local extinctions.

Bull trout are distributed throughout most of the large rivers and associated tributary systems within the Clearwater River Recovery Unit (USFWS, 2002b). There are no data to confidently estimate bull trout abundance for the entire recovery unit. However, selected sites have been sampled and density estimates made (USFWS, 2002b). Redd counts have also been conducted since the mid-1990s in Fishing (Squaw) and Legendary Bear (Papoose) creeks (USFWS, 2002b) and since 1999 in selected reaches of Newsome Creek and the East Fork of American River (Nez Perce National Forest, as cited in (USFWS, 2002b). Sources of data include historical reports, incidental bull trout counts obtained during stream habitat surveys, creel survey data, redd count data, and limited survey data obtained through bull trout sampling methodologies. It is likely that distribution and abundance is underestimated, and that some spawning and rearing areas have not been located and thus have been omitted (USFWS, 2002b).

The Clearwater River Recovery Unit consists of seven core areas, with a total of 45 local populations distributed among the core areas. The recovery team also identified 27 potential local populations for some core areas. Dworshak Dam near the confluence of the North Fork and lower (mainstem) Clearwater has likely fragmented the local population of bull trout in the Clearwater core area, and it is not known whether fish in the lower Clearwater originated from Dworshak Reservoir (Cochnauer et al., 2001). Bull trout subadults and adults have been observed every spring in a trap at the base of the dam, and during various years (1993, 1996, 1997, 2000, and 2001) at Dworshak National Fish Complex near the base of the dam (Roseberg, in litt. 2002, as cited in USFWS, 2002b).

### *3.2.6.e Critical Habitat*

A final ruling on critical habitat for bull trout in the coterminous US was made on October 18, 2010 (effective November 17, 2010) (75 FR 63898). Critical habitat for bull trout includes approximately 32,187 km (20,000 miles) of riverine habitat, 1,207 km (750 miles) of marine shoreline, and 197,487 ha (488,001 acres) of lacustrine habitat. Critical habitat spans Washington, Oregon, Idaho, Nevada, and Montana.

In Idaho, designated critical habitat for the bull trout includes areas of 24 counties, including over 8,771 stream miles, and over 170,000 lake and reservoir acres. Critical Habitat Units in Idaho include the Imnaha River Basin, Sheep and Granite Creeks, Powder River Basin, Hells Canyon Complex, Clearwater River, Mainstem Upper Columbia River, Mainstem Snake River, Malheur River Basin, Jarbidge River, Southwest Idaho Basins, Salmon River, Little Lost River, Coeur d'Alene River Basin, Kootenai River Basin, Clark Fork River Basin, and the St. Mary River Basin.

The PBFs determined to be essential to the conservation of bull trout are:

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia;
2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers;
3. An abundance of food, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish;
4. Complex shorelines with features such as large wood, side channels, pools, undercut banks, and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure;
5. Water temperatures ranging from 2 to 15°C (36 to 59°F), with adequate thermal refugia available for temperatures that exceed the upper end of this range;
6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.
7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departures from a natural hydrograph.
8. Sufficient water quality and quantity to sustain normal reproduction, growth, and survival; and
9. Low occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species.

#### *3.2.6.f Use of the Action Area*

As described in the final Recovery Plan (USFWS, 2015), the Action Area is within the USFWS designated bull trout Mid-Columbia Recovery Unit and in the geographic region within this recovery unit called the Lower Snake River geographic region. This includes eleven core areas that flow into the Snake River between its confluence with the Columbia River and the Hells Canyon Dam (i.e., Clearwater, Tucannon, Asotin, Grande Ronde, and the Imnaha basins).

Information to describe bull trout use of the Action Area is very limited but it is likely that fluvial and adfluvial form of both adults and juveniles may be present in the Action Area during their migration periods.

In the Clearwater basin, there are known subpopulations of bull trout in the Selway, Lochsa, and North Fork and South Fork Clearwater rivers (USFWS, 2002b). While little is known of the status or trends of these subpopulations, the migratory form is known to exist. Their use of the main-stem Clearwater River is seasonal, as summer water temperatures exceed those used by bull trout. (USEPA, 2004). The mainstem Clearwater River provides prey species and migration and rearing habitats for adult and subadult bull trout. It also provides connectivity among the Grande Ronde, Salmon, Imnaha, and Snake Rivers and the upper Clearwater basin local populations, although the frequency and intensity of migration between these basins is unknown (USFWS, 2002b).

Conversely, migrants from upstream of the Lower Granite reservoir (i.e., from Asotin Creek, and the Grande Ronde, Imnaha, Salmon, and Clearwater Rivers) can also potentially move freely to and from Lower Granite Reservoir. However, the USFWS (2000) has found little evidence to suggest that these subpopulations use habitat associated with the lower Snake River main-stem dams. Seasonal use of the Snake River by bull trout is likely in upriver tributaries such as the Grande Ronde and Imnaha Rivers, but these areas are substantially upstream of the Action Area (USEPA, 2004).

At the Lower Granite Dam, one bull trout was caught in the Snake River every year or two, indicating that bull trout are present in the upper end of Lower Granite Reservoir during the spring of at least some years (Bueftner, 2000). Basham (2000) indicated that the Idaho Department of Fish and Game smolt trap at Lewiston, Idaho captures an occasional bull trout, at catch rates of no more than one bull trout annually. Data from the Fish Passage Center shows no bull trout captured in the Lower Granite Dam smolt trap during the years 2006 through 2015. Because the trap is only operated during the spring, the catch information cannot be used to confirm that bull trout are absent any time of the year. Likewise, it is possible that bull trout may be passing through the Lower Granite Dam during periods when the smolt trap is not operational or the counts are not being made at the ladders (July through February and January through February, respectively).

Besides the restrictions of movement caused by the dams and the overall low population status of bull trout in the basin, use of the Action Area is limited by physical habitat conditions. Spawning and rearing habitat between the Clearwater/Snake confluence and Lower Granite Dam is limited due to high water temperatures, lack of in-stream woody debris (cover), and poor gravel substrate. The combination of these factors likely results in a low abundance of bull trout in the

Action Area. Estimated periods of presence of adult adfluvial bull trout in reservoirs like the LGDP are November through May (USACE et al., 1999).

According to ODFW (Pers. Comm. Kyle Bratcher, ODFW February 2019 to R. Labiosa USEPA), the 'vast majority of bull trout in the Snake River originate in the Imnaha River'. Based on Passive Integrated Transponder (PIT) tag data 2011-2014 (Source: Idaho Power, unpublished data from Rick Wilkerson), bull trout migrate upstream into the Imnaha from the Snake beginning in the spring and continuing into the summer months **Error! Reference source not found.**(Table 3.20). The average period the upstream movement into the Imnaha is in late April based on these four years of data. Adults move out of the Imnaha River in the fall with the average period of late November. The following graph (Figure 3.14) illustrates the temporal distribution of these upstream and downstream movements by adult bull trout. In general, the total counts are low and time-periods are protracted relative to the number of bull trout detected. These data indicate bull trout have moved out of the mainstem Snake during late spring through mid- fall.

***Table 3.20. Bull trout upstream and downstream passage dates detected at lower Imnaha River #1 (IR1; Rkm 7). (Source: Idaho Power, unpublished data summarized by Kyle Bratcher, ODFW).***

| Mean Migration Date | Date Range | n |
|---|---|---|
| **Upstream (Spring)** | | |
| 4/19/2011 | 3/10/2011 - 7/10/2011 | 36 |
| 4/22/2012 | 2/25/2012 - 7/8/2012 | 95 |
| 4/29/2013 | 2/17/2013 - 8/18/2013 | 157 |
| 4/21/2014 | 2/11/2014 - 6/28/2014 | 172 |
| **Downstream (Fall)** | | |
| 11/25/2011 | 10/28/2011 - 12/28/2011 | 30 |
| 11/22/2012 | 10/7/2012 - 1/18/2013 | 35 |
| 11/19/2013 | 10/9/2013 - 1/11/2014 | 57 |
| 11/25/2014 | 9/28/2014 - 1/27/2015 | 62 |

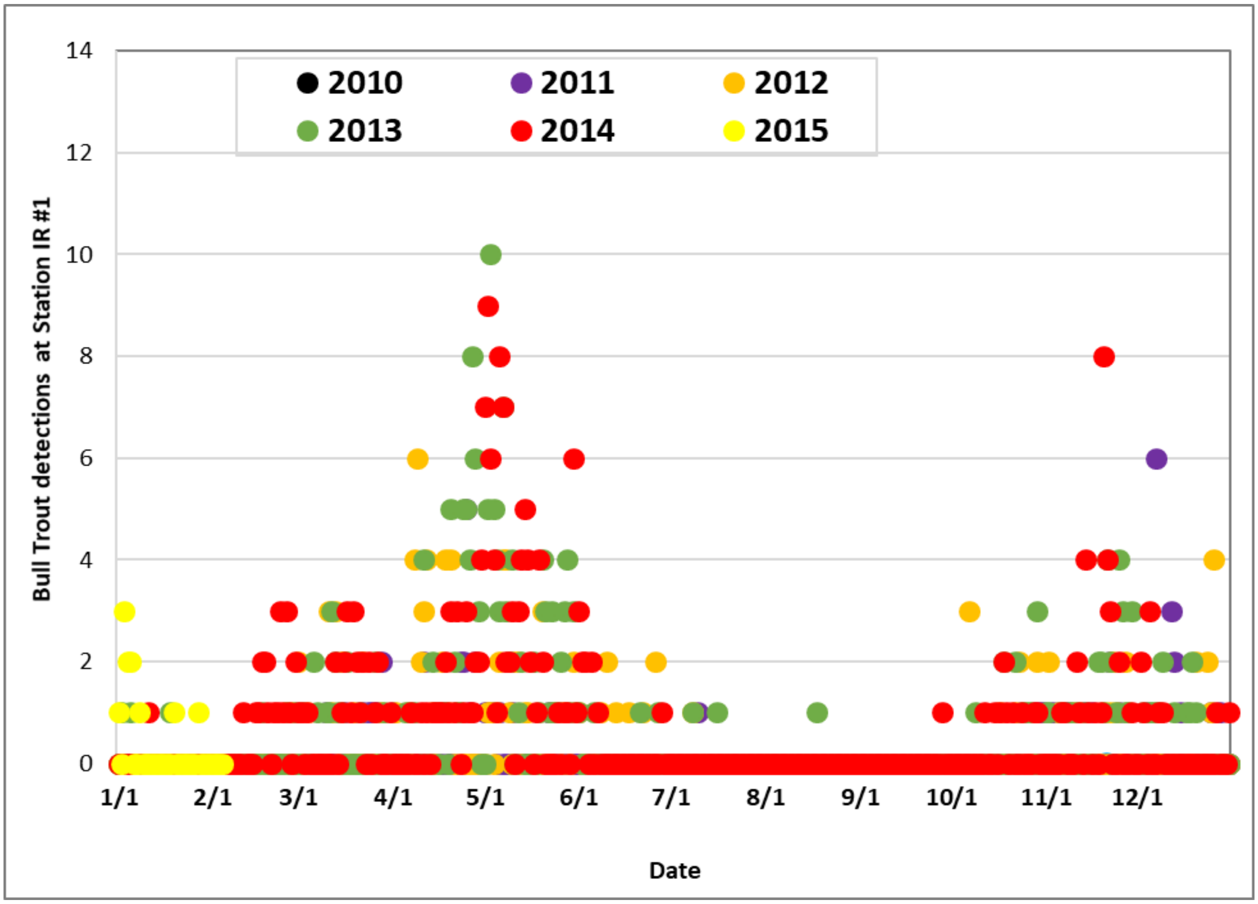


***Figure 3.14. Detections of PIT tagged bull trout movements in spring-summer (upstream) and fall (downstream) at the Lower Imnaha station (RKm 7), 2010-2015 (Source: Idaho Power, unpublished data from Rick Wilkerson;).***

One other telemetry study indicates that adult bull trout typically occur in or near the Action Area for about 7-8 months annually. Baxter (2002) used telemetry to observe bull trout seasonal migrations from the Wenaha River, a tributary to the Grande Ronde River, to the Snake River downstream of Hells Canyon. Of the bull trout that migrated from the Wenaha to the Snake River, most reached their furthest distance from the Wenaha River from late October to mid-December. Among those bull trout, return migration occurred between May and early July.

## 3.3 PLANTS

### 3.3.1 Spalding's catchfly (Threatened)

*Silene spaldingii* (Spalding's catchfly) was listed as a threatened species under the ESA on October 10, 2001 (66 FR 51598). A draft recovery plan for *S. spaldingii* was completed in 2006 with the intent to serve as a guide to the implementation of the recovery of *S. spaldingii*. No critical habitat has been designated for *S. spaldingii*.

#### *3.3.1.a Biological Requirements*

*S. spaldingii* is an herbaceous perennial plant. In general, the species is found in open, moist grassland communities, although it is occasionally also found within sagebrush-steppe communities, as well as in pine forests. The bunchgrass grasslands where *S. spaldingii* primarily occurs are characterized by one or both of two dominant bunchgrass species, such as bluebunch wheatgrass and Idaho fescue. The plant is typically found at elevations ranging from 420 to 1,555 m (1,380 to 5,100 ft), usually in deep, productive loess soils. Plants are generally found in swales or on north or east facing slopes where soil moisture is relatively higher (USFWS, 2006).

#### *3.3.1.b Factors of Decline*

*S. spaldingii* continues to be impacted by habitat loss due to human development, habitat degradation associated with domestic livestock and wildlife grazing, and invasions of aggressive nonnative plants. In addition, a loss of genetic fitness (the loss of genetic variability and effects of inbreeding) is a problem for many small, fragmented populations where genetic exchange is limited. Other impacts include changes in fire frequency and seasonality, off-road vehicle use, and herbicide spraying and drift (USFWS, 2006).

#### *3.3.1.c Population Trend*

Within the United States, *S. spaldingii* is known from three counties in Idaho (Idaho, Lewis, and Nez Perce), four counties in Montana (Flathead, Lake, Lincoln, and Sanders), one county in Oregon (Wallowa), and five counties in Washington (Adams, Asotin, Lincoln, Spokane, and Whitman) (USFWS, 2006). One occurrence is known in British Columbia, Canada; this site is located within 1 mile (1.6 km) of plants in Montana (USFWS, 2006).

Recent survey efforts in suitable habitat have resulted in the identification of 27 new populations. USFWS (2006) identified 124 separate element occurrence records of *S. spaldingii* in 85 populations, within five physiographic regions:  14 in the Blue Mountain Basins; nine in the Canyon Grasslands; 35 in the Channeled Scablands; nine in the Intermontane Valleys; and 18 in the Palouse Grasslands. When examined by state, there are 13 populations in Idaho, eight and one-half in Montana, 14 in Oregon, 49 in Washington, and one half in British Columbia, Canada (G. Glenne, *in litt.* 2004a, as cited in USFWS, 2006). The number of individual plants in each population may range from one to several thousand. None of the newly discovered populations has resulted in any significant range extension, nor are they indicative of an increase in plant vigor. The current estimated number of plants is approximately 24,500 individuals.

The Action Area for this study lies within the Palouse Grassland physiographic region. The Palouse Grasslands are extremely fertile and may comprise the world's best wheat land (Alt and Hyndman 1989, as cited in (USFWS, 2006). An underlying basalt layer is covered with deep deposits of loess and ash, forming long undulating dune-like plains of rich soils. Beginning in 1880, the Palouse Grasslands have undergone a dramatic conversion to farm lands and it is estimated that today only 0.1 percent of the grasslands remain in a natural state (USFWS, 2006). The remains of the Palouse Grasslands include small remnants in rocky areas or at field corners. Within the Palouse Grasslands, *S. spaldingii* is restricted to small fragmented populations ("eyebrows," field corners, cemeteries, rocky areas, and steptoes) on private lands, and in larger remnant habitats such as research lands owned by Washington State University. Elevations occupied by *S. spaldingii* within the Palouse Grasslands range from 700 to 1,340 m (2,300 to 4,400 ft). Of all the places where *S. spaldingii* resides, the Palouse Grasslands are the most threatened, and care is needed to maintain occupied sites and representative genetic material from these sites (USFWS, 2006).

#### *3.3.1.d Occurrence within the Action Area*

*S. spaldingii* is an upland, terrestrial species. USFWS (2006) provide maps of known populations of the species that suggest that the species are over 10 miles from the Action Area. Monitoring activities from numerous agencies and entities continue to search for new populations, but it appears that the species is not currently found within the vicinity of the Action Area. Further, the life history of the species limits its' potential occupation of a site to upland, terrestrial sites, thus eliminating its potential presence in the Action Area.

# 4. ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and ongoing impacts of all Federal, State or private actions and other human activities leading to the current status of a species, its habitat, and ecosystem within the Action Area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the Action Area that have undergone previous ESA Section 7 consultation, and the impacts of state and private actions which are contemporaneous with this consultation. The environmental baseline may not be known for all parameters of concern because they either have not been measured in the Action Area or they were not detected in the Action Area.

## 4.1 RECEIVING WATERS

The cumulative effects of agriculture, forestry, hydrosystem development, mining, grazing, and urbanization have combined to negatively affect the environmental baseline for water quality in the Lower Snake and Clearwater subbasins. As discussed in Section 2.3.5, the Snake River, the LGDP, Lindsay Creek, and Tammany Creek are 303(d) listed as water quality impaired (See Table 2.3) (IDEQ 2016). There are documented temperature and DO problems for ESA salmonids that have significantly reduced the salmonids' survival in the Lower Snake River and contributed to their decline (NMFS, 2000b).

The Lower Snake River has four locks/dams in the State of Washington: Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams. All are run-of-the river facilities. They have limited storage capacity and the flow rate through the dam is approximately the same as that entering the reservoir. The dams were built to support navigation, hydropower generation, irrigation, and recreation. Prior to their construction, the lower Snake River had an alluvial morphology consisting of a longitudinal profile of pool-riffle-run sequences. Water levels were less controlled and fluctuated by as much as 20-30 feet. The impoundment of the river converted it into a continuous reservoir system. Normal flow regimes are no longer present in the Lower Snake River, allowing sediment to accumulate and reducing natural flows in the river's mainstem.

### 4.1.1 River Morphology

The Snake River has mean annual discharge over 54,000 cfs and is the largest tributary to the Columbia River. The Clearwater River is the largest tributary to the Snake River and historically contributes about 39% of the flow to the Snake River. During summer low flow periods the Clearwater contributes about 50% of the flow with Dworshak releases. Lower Granite Dam creates the pool that is the dominant habitat feature of the Action Area. The dam is located on the Snake River at river mile 107 near Almota, Washington. The dam creates a pool that extends 39.3 miles upstream in the Snake and a further 4.6 miles into the lower Clearwater River. Impoundment of the Lower Granite Reservoir (which, as noted previously, is referred to in this document as the LGDP) is considered to end near Asotin in the Snake River arm and near the Clearwater Paper Corporation (formerly Potlatch Corporation) in the Clearwater River arm. The Dam is 3,200 feet wide and has a hydraulic head of 100 feet. The LGDP created behind the dam has a capacity of 49,000 acre-feet (normal operating range) and normal pool operation range is 733-738 ft elevation. Other physical features of the LGDP are in the following table:

| ***Table 4.1. Physical Features of LGDP*** | |
|---|---|
| Normal Pool fluctuation (weekly) | 1.5m |
| Reservoir length | 62.8 km (39.0 mi) |
| Surface Area | 3,602 h (8,900 ac) |
| Proportion of impounded reach | 25.6% |
| Maximum depth, flat pool | 42.3 m (138 ft) |
| Mean depth, flat pool | 16.6 m (54 ft) |
| Maximum width | 1128 m (3,700 ft) |
| Mean width | 6473 m (2,110 ft) |
| Major Tributaries | Clearwater River |
| *(Source: Bennet et al., 1983, as cited in USACE, 2002, Appendix B)* | |

The reservoir area exhibits a typical longitudinal impoundment gradient composed of three reach types. The uppermost portion of the LGDP is almost a riverine environment (approximately 5-15% of the impoundment gradient). This reach includes the confluence of the Clearwater and Snake Rivers, which is an important fish habitat area in the LGDP due to greater water velocity and cooler water inflow from the Clearwater River. A mid-reservoir reach represents the largest section of each impoundment and is a transition area from the lotic character to the more lentic conditions nearer the dam (67 – 72%). The reach immediately above the dam is the forebay (13-18%) that has entirely lentic characteristics (Zimmerman and Parker, 1995 as cited USACE, 2002, Appendix B).

Approximately 10% of the LGDP is shallow water habitat (Bennett et al., 1993 as cited in USACE, 2002). Many of these areas are created from in-water disposal of dredged sediment. Shallow areas are located at the shoreline of in-channel islands and some mid-channel shelf areas. Shallow water areas in the reservoir are maintained due to the relatively small fluctuations in water level (<5ft). Consistent water levels maintain benthic habitat thereby maintaining production of benthic invertebrates (fish food source). Backwaters areas, with very low water velocity, slightly warmer water, and fine substrate, are very limited in the LGDP. These areas are favored by resident warm water species (e.g., centrarchids) for spawning and rearing. Aquatic macrophyte production in the LGDP is very minor due to lack of shallow areas and backwaters.

### 4.1.2 Riparian Characteristics

Prior to inundation, the riparian habitat was composed of riparian forest palustrine scrub-shrub, and mesic shrubland. Cottonwood, white alder, and black locust dominated forested areas. Currently, riparian vegetation communities cannot develop due to the steep shorelines along the reservoirs and because these shorelines are typically covered in riprap. Riparian vegetation is limited to a narrow corridor and backwater areas. The extent of woody plant communities that once characterized the riparian zone are very limited.

### 4.1.3 Water Quality

As the Lower Snake flows through the Lewiston-Clarkson area, the water quality is potentially affected by the discharge of urban runoff and secondary- treated wastewater effluent. The sources of these discharges are the Clearwater Paper mill, and municipal wastewater treatment plants at Lewiston, Idaho and Clarkson and Asotin, Washington (USFWS, 2004).

Water quality in the Clearwater River is generally better than in the Snake River. There are fewer sources of sediment in the basin, which results in water with a sediment load much less than that of the Snake River. There are also fewer sources of contaminants. Discharge of effluent from wastewater treatment plants and industrial facilities affect water quality (USFWS, 2004).

The water quality data described were collected by USACE (1999), as well as by the Clearwater Paper Mill [Mill] (1997-2002) and are presented in NMFS (2004a) and USFWS (2004). Additional data were collected by USACE in October 2004 and March 2005 (summarized in Steevens et al., 2005b; see also Section 5.1.1). The Mill sampling encompassed monitoring stations upstream and downstream of the Mill effluent discharge in both the Snake and Clearwater Rivers. These stations are also upstream and downstream of Lewiston MS4 discharges and therefore may be used to represent baseline conditions above the Action Area and within the Action Area. In conjunction with chemical monitoring of the LLPs' outflow in October 2003 and March 2005, USACE also performed chemical monitoring of the Clearwater River upstream of the LLPs and in Lindsay Creek, which may serve as an indicator of baseline conditions in the immediate discharge area.

### 4.1.4 Temperature

Temperature alterations affect salmonid metabolism, growth rate and disease resistance, as well as the timing of adult migrations, fry emergence, and smoltification. The timing, frequency, magnitude, and duration of higher water temperatures in the lower Snake River have been affected by human actions occurring over the last 150 years. Many factors can cause high stream temperatures, but they are primarily related to land-use practices such as vegetation removal, water withdrawal, and warm irrigation return flows, and hydropower projects, rather than point-source discharges. Channel widening and land uses that create shallower streams also cause temperature increases (USFWS, 2004). The Clearwater River is also thermally affected by agricultural practices (USFWS, 2004).

Water withdrawal can lead to habitat degradation and reduced fish production. Withdrawals affect seasonal flow patterns by removing water from streams in the summer and restoring it to surface streams and groundwater in ways that are difficult to measure. Withdrawing water for irrigation, urban, and other uses can increase water temperatures and sedimentation, and reduce water quality, velocity, and habitat diversity. Return water from irrigation fields can introduce nutrients and pesticides into streams and rivers (USFWS, 2004).

Historic summer water temperatures in the Snake River basin far exceeded the optimal ranges for salmonid stocks (NPCC, 2001 as cited in NPCC, 2004). Water temperatures in the Lower Snake River are relatively cool in May and June during peak flow and snowmelt period, with typical readings ranging from 10° to 14° C. By mid- to late- July, however, temperatures usually warm up to 22°C to 24°C and remain above 20°C until late September, with the highest temperatures generally occurring from August to mid-September (BPA, 1995 as cited in NPCC, 2004).

Warm inflows delivered from upstream are the primary cause of warm temperatures in LGDP. These typically occur during the warmest climatic years with lowest river flows, generally during July and August. Clearwater River water temperatures above the LGDP typically reach a maximum of 21° C and normally exceed a base temperature of 20° C approximately five days each year. Flow augmentation with cold water from the Dworshak Reservoir on the North Fork Clearwater River is effective in reducing water temperatures in LGDP and the Lower Snake River, which has benefited migrating and rearing juvenile salmon and upstream migrating adult salmon. Although Clearwater River average water column temperature decreases with flow augmentation from Dworshak Reservoir, temperature reductions within LGDP are limited because the two river plumes do not mix well (NMFS, 2004a).

### 4.1.5 Dissolved Oxygen (DO)

As summarized in NMFS (2004a), DO concentrations at various locations in the Lower Snake River have been reported by the USACE (1999) and by U.S. Geological Survey (USGS) measurements at gauging stations, as well as by Clearwater Paper and others. Generally, DO levels in the Snake River at the head of the LGDP may be quite low in the late summer/fall low-flow period, because DO is primarily reduced by high water temperatures. Therefore, DO levels in the period from July through September are the lowest of the year.

The concentration of DO was measured at upstream locations in the Snake and Clearwater Rivers, and at five downstream locations in the Snake River as part of the previously mentioned Receiving Water Studies conducted by the Mill from 1997-2002. During this time, the DO concentration at the upstream monitoring location on the Snake River ranged from 5.9 mg/L to 14.4 mg/L, with a mean of 8.59 mg/L. At the upstream location on the Clearwater River, the mean DO concentration ranged from 9.72 mg/L to 12.88 mg/L, with a mean of 10.75 mg/L. At the five downstream locations, the mean DO ranged from 8.68 mg/L to 9.15 mg/L.

Mean DO concentrations measured by USACE in 2004 and 2005 (Steevens et al., 2005b) ranged from 10.092-12.65 upstream of the Action Area in the Clearwater River and 10.4-11.8 in Lindsay Creek.

### 4.1.6 Total Suspended Solids (TSS) and Nutrients

Larger, mostly inorganic, particles transported by the Snake and Clearwater Rivers settle out in the upper parts of the LGDP. Fine suspended sediment and organic material is transported further downstream into LGDP and other downstream reservoirs before settling out on the bottom. The highest concentrations of TSS usually occur during peak flows. Outside high flow periods, background TSS concentrations in LGDP usually range from 10-20 mg/L (USACE, 1999 as cited in NMFS, 2004a).

Generally, high concentrations of total nitrogen in the Middle-Snake River above LGDP are diluted by low concentrations in the Clearwater River. After the two rivers mix, the LGDP contains moderately high levels. Total nitrogen levels increase considerably during fall in the Lower Snake River, with concentrations reaching 0.8 mg/L to 1.1 mg/L in October. This late season increase may be due to a reduction in plant uptake associated with aquatic plant and algae dying back or going dormant and agricultural harvesting in the watershed. Early fall rains after prolonged dry periods also increase nutrient concentrations, although a corresponding increase in TSS levels was not detected. Nitrate levels also follow this seasonal pattern, with highest levels in spring and fall (USACE, 1999 as cited in NMFS, 2004a).

Limnological conditions in the Lower Snake River impoundments have generally been considered to be in the upper mesotrophic category (USACE, 1999; Falter, 2001 as cited in NMFS, 2004a). Based on a review of 1997 data, the average phosphorus levels throughout the Lower Snake River appear to be in the 0.03 mg/L to 0.04 mg/L range during mid-summer and slightly higher (near the 0.06 mg/L to 0.07 mg/L range) during June and the fall months. This would suggest that the average phosphorus levels during summer in LGR would allow eutrophic conditions (USACE, 1999 as cited in NMFS, 2004a).

TSS concentrations and turbidity levels were measured at upstream locations in the Snake and Clearwater Rivers, and at five downstream locations in the Snake River as part of the Receiving Water Studies conducted by the Mill from 1997-2002. During this period, the TSS concentration at the upstream monitoring location on the Snake River ranged from 2.8 mg/L to 15.1 mg/L, with a mean of 5.4 mg/L. At the upstream location on the Clearwater River, the TSS concentrations ranged from non-detect to 11.6 mg/L, with a mean of 2.4 mg/L. At the five downstream stations, mean TSS concentrations ranged from non-detect to 2 mg/L. Turbidity at the upstream monitoring location on the Snake River ranged from 0.71 NTU to 9.4 NTU, with a mean of 3.1 NTU. At the upstream location on the Clearwater River, the turbidity levels ranged from 0.48 NTU to 8.5 NTU, with a mean of 1.8 NTU. At the five downstream locations, mean turbidity levels ranged from 0.94 NTU to 1.3 NTU.

Mean turbidity levels measured by USACE in 2004 and 2005 (Steevens et al., 2005b) ranged from 1.6 to 2.15 NTU upstream of the Action Area in the Clearwater River and 1.5-2.7 NTU in Lindsay Creek.

### 4.1.7 pH

The pH was measured at upstream locations in the Snake and Clearwater Rivers, and at five downstream locations in the Snake River as part of the Receiving Water Studies conducted by the Mill from 1997 through 2002. During this time, the pH at the upstream monitoring location on the Snake River ranged from 7.24 to 8.91, with a mean of 8.01. At the upstream location on the Clearwater River, the mean pH ranged from 6.97 to 8.48, with a mean of 7.58. At the five downstream locations, pH ranged from 8.1 to 8.24.

Mean pH measured by USACE in 2004 and 2005 (Steevens et al., 2005b) ranged from 7.4 to 8.2 upstream of the Action Area in the Clearwater River and was measured as 8.2 in Lindsay Creek.

### 4.1.8 Substrate Quality

Salmon require clean gravel for successful spawning, egg incubation, and emergence of fry. Fine sediments clog the spaces between gravel and restrict the flow of oxygen-rich water to the incubating eggs (USFWS, 2004).

The Snake River can, at times, have extremely high sediment loads, due in part to soil erosion from agricultural and other land management practices. Because the sediment quality is influenced by runoff from agricultural areas, industrial discharges, and other non-point discharges, the sediments tend to be highly enriched with nitrate and other nutrients and also contain detectable levels of herbicides and pesticides, dioxins, heavy metals, and polyaromatic hydrocarbons (PAHs) (USFWS, 2004).

The lower Snake River reservoir system accumulates approximately 3-4 million cubic yards of sediment per year, much of that within the LGDP. The large inputs of sediment have necessitated dredging, which began in 1986. Sediments in the Action Area have accumulated chemical contaminants, including dioxin, metals, pesticides, herbicides, ammonia and nitrogen (NMFS, 2004a).

## 4.2 HABITAT VALUES

The installation of the Lower Granite Dam converted the Action Area from a lotic to lentic system, which has resulted in radically different salmonid habitat conditions. Historical and recent photos illustrate these differences (Figure 4.1, Figure 4.2, and, Figure 4.3). The confluence of the Snake and Clearwater rivers at Lewiston had overall greater physical complexity and hydraulic diversity in the form of shallow water areas, alluvial substrate, side channels, and backwaters. As reviewed by Tiffan et al. 2016 habitat features prior to impoundment were comprised of shorelines and shallow areas with alluvial substrate. These shallows occurred in long connected stretches thereby supporting the migratory strategy of continuous movement downstream of subyearling fall Chinook. These areas provided cover and invertebrate production (important food source).

In contrast, the confluence is now within the upper end of the LGDP where the habitat is dominated by deep water and slow current and lacks the hydraulic and physical complexity of the pre-dam condition. Limited cover is provided by water depth and by shorelines.

***Figure 4.1. View of the Snake-Clearwater confluence to the south with Clearwater on left (Photo by Asahel Curtis 1917, UW photo Archive).***

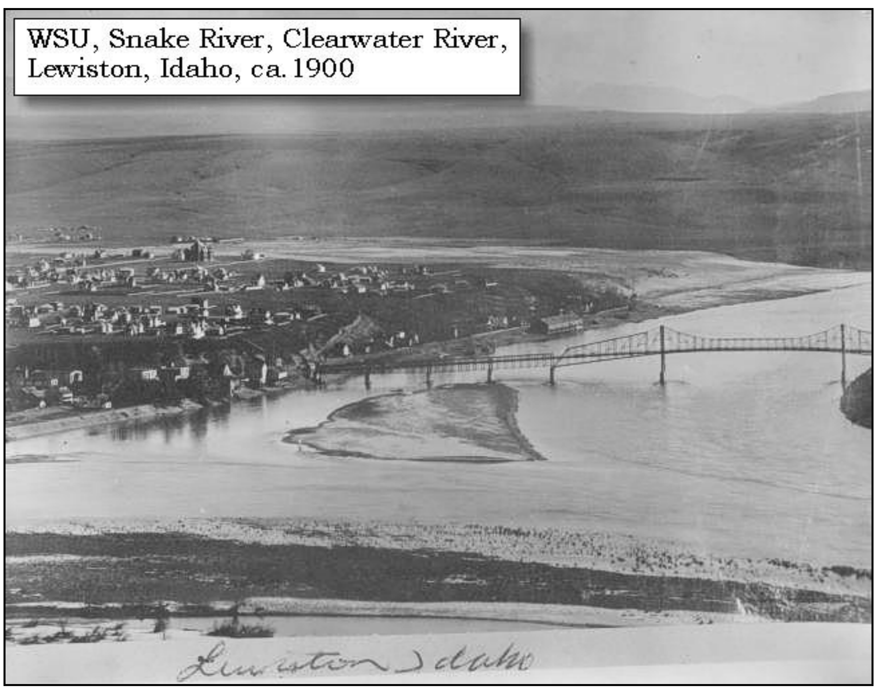


***Figure 4.2. View of Snake/Clearwater confluence at Lewiston 1900 (Source: WSU photo archive).***

***Figure 4.3. Modern aerial photo of Snake/Clearwater confluence at Lewiston (2000 by Jim Wark).***

Shorelines are now characterized by riprap and large natural substrate, generally considered inferior habitat for subyearlings and salmonids. The current structure of this habitat is now fragmented patches suitable for salmonids (specifically subyearlings) interspersed with poor habitat (but used by predatory fish). Tiffan et al. (2016) estimated habitat for subyearling Chinook in LGDP using a two-dimensional hydrodynamic modelling, physical habitat data, values from an existing habitat model (Tiffan et al, 2002) and fish abundance (both chinook and smallmouth bass) to estimate and quantify high-probability rearing habitat and to draw inferences on predation risk. Shorelines of low suitability for subyearlings were riprapped (46% of shoreline) or had large natural substrate (boulders). In the lower 2/3 of the LGDP, natural shorelines are steep often with cliffs and talus. Only 29% of the LGDP were predicted to be suitable habitat. These areas occurred more in the upper end of the reservoir as the presence of suitable shoreline habitat is related to areas with low sloping topography (more dominant topography in the upper portion). Most riprap is on the north side of the LGDP and the Clearwater River arm. This material is used to protect the levees and other structures near the shoreline.

In riverine habitats, salmonids use cover in the form of structural and hydraulic complexity as protection from predators. Where these features are lacking in reservoirs, salmonids (specifically outmigrants) use depth and pelagic orientation to avoid predators. Natural rock and riprap along the shore are habitat features favored by non-native smallmouth bass (*Micropterus dolomieu*). This species is now abundant in LGDP and are considered effective predators on salmonids. A study by Erhardt et al. (2018) determined that smallmouth bass (*Micropterus dolomieu*) were a significant predator of subyearling Chinook salmon in LGDP, which are vulnerable because of size, extent of time in the reservoir, and their use of shoreline areas which often overlaps with or are in close proximity to the smallmouth bass habitat. Piscivorous birds and mammals also prey on salmonids from these rocky shorelines.

Foraging is also affected by the loss of lotic habitat in this system. Tiffan et al. (2014) found that the diets between riverine and reservoir habitats used by subyearling Chinook in the Snake River varied in the amount of energy provided for growth. Greater growth rates of subyearlings in the riverine habitat was attributed to higher energy density of the diet consisting of insects (e.g. Diptera, Ephemeroptera, and Trichoptera families) with a high proportion of adult terrestrial forms. In contrast, the juvenile salmon reservoir diet had large portion of the mysid Neomysis mercedis and lentic amphipods Corophium spp. These prey items contain lower energy than many insects especially adult forms.

Historical habitat loss is a primary limiting factor in degradation of critical habitat for fall/spring/summer run Chinook resulting in impacts to juvenile and adult salmon. This habitat degradation contributes to elevated water temperature, presence of invasive plants and warmwater piscivores which prey on and contribute to the low survival of juvenile Snake River fall Chinook salmon (Erhardt et al. 2018; NMFS 2019).

Habitat characteristics that are important to survival and conservation of salmonids present within the Action Area are described in their Critical Habitat Designations, which are summarized in Table 3.4. These features are also relevant to the bull trout. The following subsections focus on impacts to PFBs for specific life-stages.

### 4.2.1 Juvenile Migration

The conversion from a lotic to a lentic system affects habitat availability and the duration of movement of juveniles in the system. The slow, deep-water habitat that dominates the Action Area provides little cover in the form of riparian features, large woody debris, substrate, and off channel areas. The reservoir has low water velocity, thus, the natural transport provided to juveniles migrating downstream is reduced which may increase stress and energy expenditure. Juveniles are more susceptible to predation from both piscivorous fishes and birds in this modified habitat (less cover and longer duration of exposure). Finally, passage at the dam facility can result in injury or mortality.

Dam operation has been modified to reduce some of the negative impacts to migrating juveniles including the following:

- Flow augmentation. Dworshak Dam releases water to increase flow to reduce travel time of juvenile migrants through the system. The decreased travel time reduces exposure of juveniles to predators and to reservoir conditions /potential hazards. Approximately 1.9 MAF of the Snake River Basin storage is made available for augmentation.
- Reservoir drawdown. Lower Granite Dam is operated within one foot of the Minimum Operating Pool (MOP) from April 3 through November 15 annually to increase water velocity, decreasing juvenile travel time.
- Temperature Control. Summer releases of cold water from the Dworshak Dam reduce temperatures in the Lower Granite Reservoir to improve water conditions for migrating adults (fall Chinook and sockeye) and juvenile fall Chinook salmon. Noteworthy, however is the fact that the reduced water temperature in the lower

Clearwater River tends to reduce the growth of fall Chinook rearing in this area and retards the onset of smoltification and downstream migration.

- Surface bypass collector. Collects downstream migrants and routes them through a low volume spillway or to collection area for downstream transport. This system reduces stress to juveniles because they do not experience the pressure changes associated with screen bypass systems. Also, fish enter the bypass near the surface which is where they are normally located in the water column.
- Behavioral guidance structures. Attracts surface-oriented fish in the dam forebay and directs fish away for the powerhouse and towards the surface bypass collector.
- Spillway flow deflectors. Decrease water turbulence as the water plunges over the dam. This reduces levels of total dissolved gas that are harmful to migrating juveniles. The mainstem Snake River from its confluence with the Clearwater River to its mouth at the Columbia River is under a TMDL that addresses total dissolved gases (TDG) (WA Ecology, 2003). TDG are elevated to levels that exceed state standards due to spill events at four hydroelectric dams on the Lower Snake River: Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams.

### 4.2.2 Spawning Habitat

Of the ESA fish species addressed in this BE, only fall Chinook salmon would possibly use the Action Area for spawning. Installation of the Lower Granite Dam effectively eliminated Chinook salmon spawning habitat in most of the Action Area. Chinook require lotic habitat for spawning, with gravel/small cobble substrate with adequate water movement or upwelling to oxygenate eggs and to remove built up of nitrogenous waste. Groves and Chandler (1999) describe the range of fall chinook spawning habitat in the Snake River as having substrate-level water velocities of 0.1-2.1 m/s and substrate size of 2.5-15.0cm. Some incidental spawning by fall Chinook salmon has been found to occur in the tailrace of the Lower Granite Dam (Dauble et al., 1999). However, physical characteristic required for adequate spawning habitat are not found in the Action area above the dam.

### 4.2.3 Rearing and Maturation Habitat

Juvenile Chinook salmon rear in a wide-variety of environments ranging from small infertile streams to large rivers and impoundments. Rearing juvenile fall chinook have been documented to use the limited island shorelines and other shallow areas available in the Action Area. These areas are important habitat for rearing subyearlings and for short-term foraging for outmigrating yearling chinook and steelhead smolts. These areas have low gradient shoreline and fine sediment substrate.

### 4.2.4 Adult migration

Adult salmon/steelhead have an open deepwater migration corridor through the Reservoir that primarily provides migration space. Besides deep water cover, the reservoir habitat offers little habitat diversity in terms of substrate, velocity, cover, or riparian features. The confluence of the Snake/Clearwater does provide greater habitat value to migrants due to presence of pool habitat, greater flow velocity, and cold-water inflow from the Clearwater.

# 5. EFFECTS OF THE ACTION

This BE evaluates the potential consequences associated with the stormwater discharges authorized by the Permits identified in Sections 1 and 2.2. The analysis of impacts assumes that the ESA-listed species and their prey are exposed to conditions that may exist if the NPDES permit conditions are met. Potential impacts arising from violations of permit conditions are not evaluated.

USFWS and NMFS provide guidance (USFWS & NMFS, 1998) and implementing regulations (50 CFR 402) for evaluating potential effects to listed species. The most recent revision of the interagency implementing regulations for Endangered and Threatened Wildlife and Plants; Regulations for Interagency Cooperation was published in August and implemented in October 2019 (84 FR 44753). The analysis and format of this BE are consistent with the revised regulations. According to the revised regulations, the *"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."* The Services no longer require the effects of the action to be broken out by direct, indirect, interdependent and interrelated effects. Therefore, this BE includes an analysis of effects consistent with this revised regulation and does not consider these potential effects separately.

Stormwater enters the Clearwater and Snake Rivers through point and non-point sources, such as the LLPs, individual storm drains, and overland flow. The stressors generated by the action include pollutants entering these receiving waterbodies from multiple stormwater discharge outfalls within the Action Area. These stressors potentially affect water quality and may affect listed species through direct exposure and a reduction in prey. The stressors may also affect the PBFs of designated critical habitat for some species. Therefore, EPA conducted a hazard analysis using a deterministic risk assessment approach to evaluate the impact of these water quality stressors on ESA-listed species, their prey, and designated critical habitat.

Aside from limited sampling conducted by the USACE (see Section 5.1.1), there is no site-specific monitoring data available. Therefore, the analysis within this BE relies on other stormwater characterization reports from Western Washington to predict end-of-pipe (EoP) concentrations of stormwater pollutants. This approach is used in EPA's previous ESA evaluation supporting its NPDES Permit Actions for MS4 discharges from Federal and Tribal facilities to Puget Sound. The resulting EoP concentrations are used to develop exposure point concentrations (EPCs) for the toxicity assessment described in Section 5.3.

## 5.1 STRESSOR IDENTIFICATION

A subset of the pollutants associated with stormwater discharges permitted under EPA's Permit Actions are considered stressors. The following sections describe the available datasets and the rationale for focusing the hazard analysis on a subset of focal pollutants that are most likely to result in toxicity to ESA-listed species and their prey.

### 5.1.1 Lewiston Levee Reports

The USACE Walla Walla District collected water samples from the outflow of four LLP pump stations, Lindsay Creek, and from the Clearwater River upstream and downstream of the LLP discharge points on March 15, 2004 and October 12, 2005. (Juul, 2004; Carroll, 2005; Steevens et al. 2005a and 2005b.) Through this chemically comprehensive data collection effort, the USACE measured over 200 organic, inorganic chemicals and biological parameters from 15 stations. These included semi- volatile and volatile compounds, herbicides, petroleum products, metals, metalloids, conventional and biological parameters. While the USACE also sampled Lindsey Creek to provide comparison data between an un-impounded stream (Steevens, et al 2005b) and man-made ponds, EPA considered the data collected from Lindsay Creek, along with other samples collected by USACE, as representative of stormwater discharges in the Action Area. These data were also used to investigate the potential for impacts to Chinook salmon, Steelhead trout, Sockeye salmon and bull trout, and from exposure to potentially elevated levels of dioxins, organic chemicals, metals, and nutrients discharged from the ponds. (.

Fish tissue data were also collected by IDEQ for the analysis of Dioxins and Furans [specifically, polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs)] that are not readily detectable in surface water. (IDEQ, 2004).

These sampling efforts, listed below, are collectively referred to herein as the Lewiston Levee Reports, and are incorporated by reference into this BE:

- Juul (2004). *Water-Quality Assessment of The Clearwater River and Lewiston Levee Pond Pumpage: October 2004 Sample Event. Final Report. December 2004*.
- IDEQ (2004). *Summary Report - PCDD/F Fish Tissue Sampling in Lewiston Surface Water Ponds 2004.*
- Steevens, et al. (2005a). *Summary and analysis of dioxin, metal, and nutrient concentrations in outflow of levee ponds in Lewiston, Idaho. Summary. January 31, 2005*.
- Steevens, et al. (2005b). *Summary and analysis of dioxin, metal, and nutrient concentrations in outflow of levee ponds in Lewiston, Idaho. Final Report*. *August 13, 2005.*
- Carroll (2005). *Draft Water-Quality Assessment of The Clearwater River and Lewiston Levy Pond Pumpage, Field Sampling and Analysis [in] March 2005; April 25, 2005*.

Because there were only two sampling events, EPA did not screen the constituents on a percent detected basis, as is normally done. Furthermore, a number of constituents were reported with qualifiers, for example: undetected (U), estimated (J), fails acceptable criteria (*), or hit above the method reporting limit (MRL), while found in the method blank (B). Those data, with an exception for PAHs, were not considered in this BE. Although some of the data for PAH was reported with qualifiers, since the MRL for some of the PAHs exceeded the final chronic values based on the equilibrium partitioning, they were included in the analysis presented in this BE (Section 5.4).

The following points summarize some of the key findings from Carroll (2005) and Steevens et al. (2005b):

- A total of 205 individual constituents were analyzed including organic herbicides and pesticides.
- The organochlorine pesticides, organophosphorus pesticides, chlorinated herbicides, polychlorinated biphenyls (PCBs), and semi-volatile organic compounds were not detected at levels above the MRLs (Juul, 2004).
- Toluene was reported at 0.2 µg/L above the MRL (0.05 µg/L), but not considered further in Steevens et al (2005b). No other volatile organic constituents were detected.
- The dioxin 2,3,7,8- TCDD was not detected in any of the water samples, while five isomers were either below the MRL or detected in the associated lab blank. The dioxins and furans when detected in fish tissue were present at concentrations well below any level of potential concern to the fish species of concern (Steevens et al., 2005b; Van den Berg et al., 1998).
- Ammonia – nitrogen concentrations were greatest in Pond A, however none of the river samples showed an exceedance of the MRL.
- Total cyanide, semivolatile petroleum products, volatile petroleum products, and biochemical oxygen demand results were all below MRLs.
- Mercury concentrations were reported below the minimum detection level; however, it may be present in samples at levels greater than the Idaho CCC (Steevens et al. 2005b).

While the USACE dataset is chemically comprehensive, it is limited in size and duration. Therefore, it is not considered representative of runoff during a storm event, the stormwater characteristics from different land uses within the MS4, nor the stormwater discharges as the samples were collected from the levee ponds (not at the point of discharge). For example, the concentration of a given parameter will vary throughout a storm or discharge event and a grab sample will only capture the concentration of that pollutant at that precise time during the storm event – it will not be representative of the storm event as a whole. Despite these limitations, the data were used to calculate EoP concentrations in stormwater runoff from each land use type within the Action Area for each of the focal pollutants (see Section 5.2.3).

### 5.1.2 Puget Sound Toxics Report

The report entitled *Control of Toxic Chemicals in Puget Sound Phase 3 Data and Load Estimates* (Puget Sound Toxics Report) summarizes an extensive multi-year effort to characterize and estimate toxic chemical loadings from surface water runoff into Puget Sound in Washington State (Herrera, 2011). In this case surface water runoff includes stormwater, nonpoint source overland flow, and groundwater discharges to surface waters. The goals of this study were to: (1) improve pollutant loading estimates developed during the Phase 1 and Phase 2 Control of Toxic Chemicals in Puget Sound studies; (2) improve understanding of the impacts of storm events on pollutant loadings to Puget Sound; (3) evaluate land use impacts on pollutant loadings to Puget Sound. The four types of land use included in this study were: commercial/industrial, residential, agricultural, and forest/field/other. Each land use was represented by two sub-basins within the Snohomish River watershed and two sub-basins within the Puyallup River watershed.

This study analyzed instream water quality samples collected during 2009-2010 from streams for eleven classes of pollutants and samples were collected during six defined storm events (minimum of 0.25 inches of precipitation in 24 hours and an antecedent dry period of 12 hours) and during two dry periods. All samples were grab samples conducted instream.

According to the Puget Sound Toxics Report, for all land uses, concentrations of toxic pollutants in monitored rivers and streams were higher during storm events than during baseflow (Herrera, 2011). Higher contaminant concentrations were measured for nutrients and metals during the dry season (May through September). This is likely the result of pollutants and contaminants building up during the dry season and being washed into the receiving waters during first flush events. Additionally, the highest concentrations of pollutants and most frequent events of water quality exceedances for toxic compounds were from basins that contained numerous commercial and industrial operations.

The Puget Sound Toxics Report notes that its use of instream sampling to characterize pollutant loading by land use may underestimate pollutant loading from areas that discharge runoff through stormwater conveyance systems like the Lewiston Area MS4s. However, given the comprehensive quality of this study as a whole, EPA uses the data from this study to calculate EoP concentrations for each of the focal pollutants present in runoff from the land use types within the Action Area (see Section 5.2.3).

### 5.1.3 Western Washington Report

The *Western Washington NPDES Phase 1 Stormwater Permit: Final Data Characterization 2009-2013* (Western Washington Report) compiles stormwater discharge data from municipal stormwater permittees in western Washington as required by the Washington Department of Ecology under the 2007 Phase I Municipal Stormwater Permit (Hobbs et al., 2015). The goals for this monitoring program included: (1) establishing a baseline of municipal stormwater discharge data in western Washington; (2) characterizing stormwater discharge variability across different land uses and seasons; and (3) identifying pollutants of concern associated with municipal stormwater discharges.

Washington Department of Ecology designed this monitoring program to collect representative stormwater data across the Puget Sound area. Flow-weighted composite samples were collected between 2009 to 2013 and were analyzed for up to 85 parameters across four land uses during the wet and dry seasons in western Washington. The land uses analyzed included industrial, commercial, high density residential, and low density residential. Permittees were required to select monitoring locations based on these land use types. Each monitoring location was categorized by the predominant land use type found in its sub-basin and the resulting monitoring data was used to characterize runoff from that land use type.

The Western Washington Report presents data from 44,80 records, representing approximately 597 storm events. The detection frequency was found to vary across land use. Metals, phthalates, phenols, and PCBs had higher detection frequencies and concentrations in samples from commercial and industrial land uses as compared to low density residential, high density residential, and open space. The data from this report were used in the EoP concentration calculations for each of the focal pollutants present in runoff from the land use types within the Action Area (see Section 5.2.3).

### 5.1.4 Focal Pollutants

EPA relied on the empirical data collected and analyzed in the Lewiston Levee Reports (Juhl, 2004; IDEQ 2004; Steevens et al. 2005b; and Carroll, 2005) to select the list of stormwater chemicals for analysis in this BE. This comprehensive data collection effort generated a dataset comprised of organic, inorganic, and biological parameters.

As noted above in Section 5.1.1., a majority of the constituents evaluated by the Lewiston Levee Reports were either not detected or were below the MRL, therefore, with the exception of PAHs, EPA opted to exclude those constituents from the focal pollutant list. Additionally, any constituents that were reported with qualifiers (e.g. undetected, fails acceptable criteria, etc…) were also excluded from the BE focal pollutant list.

Although PAHs were generally detected at levels below the MRL, they were included in the focal pollutant list because the MRL for some of the PAHs exceeded the final chronic values based on equilibrium partitioning and due to their prevalence in stormwater runoff. Additionally, although mercury was detected at a level less than the minimum detection limit, Steevens et al. (2005b) reported that it may have exceeded Idaho's criterion continuous concentration (CCC) and, therefore, it was included for further analysis in this BE.

The final list of focal pollutants is presented below (Table 5.1).

***Table 5.1 List of Focal Stormwater Pollutants***

| **Pollutant Class** | **Pollutant*** | | | | |
|---|---|---|---|---|---|
| ***Metals*** | Aluminum | Beryllium | Copper | Mercury (total) | Thallium |
| | Antimony | Cadmium | Iron (total) | Nickel | Titanium |
| | Arsenic | Chromium | Lead | Selenium | Vanadium |
| | Barium | Cobalt | Manganese | Silver | Zinc |
| ***PAHs*** | 1-Methylnaphthalene | Anthracene | Benzo(g,h,i)perylene | Fluoranthene | Phenanthrene |
| | 2-Methylnaphthalene | Benz(a)anthracene | Benzo(k)fluoranthene | Fluorene | Pyrene |
| | Acenaphthene | Benzo(a)pyrene | Chrysene | Indeno(1,2,3-cd) pyrene | |
| | Acenaphthylene | Benzo(b)fluoranthene | Dibenzo(a,h)anthracene | Naphthalene | |

*Pollutants are the dissolved form unless otherwise noted.*

## 5.2 PREDICTION OF POLLUTANT EXPOSURE POINT CONCENTRATIONS

Concentrations of focal pollutants in stormwater runoff were estimated for the MS4s and ultimately compared to effects thresholds of listed species (Section 5.3). First, EPA characterized the drainage areas within the MS4 boundaries. Using this information, along with pollutant concentration data from existing sources, EPA estimated the concentration of the focal pollutants in runoff from specific land use types. Together, this information was used to estimate the concentration of a focal pollutant in runoff from each of the drainage basins. The following subsections provide a more detailed description of these characterizations and calculations.

### 5.2.1 Drainage Basin Characterization

The *Lewiston 2001 Stormwater Master Plan* (Lewiston Plan) contains information for 20 basins and the respective sub-basins within the City's MS4 jurisdiction. Basin level information includes drainage area (acres), average curve number (CN), and primary land uses. There are six land use types within the boundaries of the MS4s: low density residential (LDR), high density residential (HDR), commercial (COM), industrial (IND), parks/open space/recreational (OPEN), and western desert (DES) (Lewiston, 2001). The Lewiston Plan did not provide a precise breakdown of the area of each land use type within a basin or sub-basin. Therefore, EPA used an iterative approach to estimate the area of each land use type by solving for the average CN value, which was provided.

For example, each sub-basin is generally comprised of multiple land uses, each of which are different sizes and have different CN values. For a given sub-basin comprised of two land use types (e.g. "land use 1" and "land use 2"), each land use contributes to the sub-basin in the following way:

$$Area_1 * CN_1 + Area_2 * CN_2 = Area_{sub-basin} * CN_{sub-basin}$$

This equation can be simplified by dividing both sides by the area of the sub-basin so it becomes a function of land use percentage ("$a$"):

$$a_1 * CN_1 + a_2 * CN_2 = CN_{sub-basin}$$

As noted above, the Lewiston Plan provides CNs for each land use type and the average CN for each sub-basin. The unknowns from the equation above are $a_1$ and $a_2$, however, it is known that $a_1$ plus $a_2$ must equal 100%. Using this information, EPA solved the equation iteratively by using a series of estimated values for $a_1$ and $a_2$ until the combination resulted in the known sub-basin CN value.

For example, sub-basin B (of the 21$^{st}$ Street/Thain Road Basin; see page 40 of the Lewiston Plan) has an area of 940 acres, an average CN of 82, is comprised of LDR, HDR, and COM land use types (no OPEN or DES land use types reported) and the CNs by land use are 75, 85, and 92, respectively. Using the above equation:

$$a_{LDR} * 75 + a_{HDR} * 85 + a_{COM} * 92 = 83$$

This equation is true when using the following land use percentages:

$$a_{LDR} = 40\% \quad a_{HDR} = 35\% \quad a_{COM} = 25\%$$

Repeating the same process for sub-basins A and C:

***Table 5.2 Estimated land use type percentages for sub-basins in Basin #7.***

| Sub-basin | LDR | HDR | COM | Average CN |
|---|---|---|---|---|
| A | 60% | 0% | 40% | 82 |
| B | 40% | 35% | 25% | 83 |
| C | 40% | 35% | 25% | 83 |

This process was repeated for every sub-basin until all calculated CNs matched those found in the Lewiston Plan and the percentage of a given land use fit the narrative description of the sub-basin.

Next, the land use percentages for each sub-basin were aggregated to determine the land use percentages across each of the twenty basins. Percent of land use Y in a given basin comprised of sub-basins A, B, and C is equal to the sum of acres of Y in each sub-basin divided by the sum of total acres of all sub-basins.

$$\%\,Y = \frac{Area_{A,Y} + Area_{B,Y} + Area_{C,Y}}{Area_A + Area_B + Area_C}$$

Total acres of each sub-basin are given in the Lewiston Plan. To find the acres of a land use type in a sub-basin, the percentage of that land use in the sub-basin (previously calculated above) is multiplied by the total acres of the sub-basin and the above equation becomes:

$$\%\,Y = \frac{(a_{A,Y} * Area_A) + (a_{B,Y} * Area_B) + (a_{C,Y} * Area_C)}{(Area_A + Area_B + Area_C)}$$

For example, Basin #7 (the 21st Street/Thain Road Basin; see page 40 of the Lewiston Plan) has a total area of 1,591 acres, an average CN of 83, and is comprised of sub-basin A (281 acres), sub-basin B (940 acres), and sub-basin C (370 acres). The above table (Table 5.2) calculated the percentage of each land use of sub-basins A, B, and C. Using this information, and the equation presented below, the percentage of Basin #7 that is LDR, for example, is 44%:

$$\%\,LDR = \frac{(60\% * 281) + (40\% * 940) + (40\% * 370)}{(281 + 940 + 370)}$$

This calculation is repeated for each of the land use types found in Basin #7:

$$a_{LDR} = 43.5\% \quad a_{HDR} = 28.8\% \quad a_{COM} = 27.6\%$$

Finally, the average CN of a basin is the sum of all calculated land use percentages multiplied by the respective land use CN given in the Lewiston Plan.

$$average\ CN_{basin} = a_{LDR} * CN_{LDR} + a_{HDR} * CN_{HDR} + \cdots$$

When the calculated CN of a basin did not equal the given CN found in the Lewiston plan, land use percentages at the sub-basin level were adjusted until the calculated sub-basin CNs and calculated basin CN matched those found in the Lewiston Plan. The land use percentages for 18 of the 20 Lewiston basins are summarized in Table 5.3 (below). The Lewiston Plan does not have any information for Basins #16 and #17. EPA ultimately used these calculated percentages of land use types to estimate end-of-pipe concentrations of typical pollutants found in stormwater discharges for each basin.

***Table 5.3. Estimated land use type percentages for each drainage basin in the Lewiston UA.***

| **Basin No.** | **LDR** | **HDR** | **COM** | **IND** | **OPEN** | **DES** |
|---|---|---|---|---|---|---|
| **1** | 100% | 0% | 0% | 0% | 0% | 0% |
| **2** | 100% | 0% | 0% | 0% | 0% | 0% |
| **3** | 80% | 10% | 10% | 0% | 0% | 0% |
| **4** | 50% | 12% | 12% | 0% | 26% | 0% |
| **5** | 100% | 0% | 0% | 0% | 0% | 0% |
| **6** | 32% | 32% | 36% | 0% | 0% | 0% |
| **7** | 43.5% | 28.8% | 27.6% | 0% | 0% | 0% |
| **8** | 100% | 0% | 0% | 0% | 0% | 0% |
| **9** | 85.6% | 0% | 0% | 0% | 5.6% | 8.7% |
| **10** | 65% | 25% | 10% | 0% | 0% | 0% |
| **11** | 70% | 20% | 10% | 0% | 0% | 0% |
| **12** | 40% | 60% | 0% | 0% | 0% | 0% |
| **13** | 13% | 28% | 54% | 0% | 5% | 0% |
| **14** | 48.5% | 33.6% | 9.3% | 0% | 8.6% | 0% |
| **15** | 0% | 0% | 4% | 87% | 9% | 0% |
| **16** | *NA* | | | | | |
| **17** | *NA* | | | | | |
| **18** | 0% | 0% | 0% | 100% | 0% | 0% |
| **19** | 50% | 0% | 30% | 20% | 0% | 0% |
| **20** | 100% | 0% | 0% | 0% | 0% | 0% |

LDR: low density residential
HDR: high density residential
NA: Information Not Available
COM: commercial
IND: industrial
OPEN: open space
DES: western desert

## 5.2.2 Estimated Pollutant Concentrations for Each Land Use Type

EPA calculated the expected concentration of each focal pollutant in stormwater runoff from each land use type in the Lewiston MS4 area. As noted above, the Lewiston MS4 basins are made up of six land use categories: LDR, HDR, COM, IND, OPEN, and DES. However, EPA assumes that there will be no stormwater runoff from the western desert (DES) land use type (found only in Basin 9) as any precipitation that falls on that land type likely infiltrates the ground before reaching a surface waterbody. Since the three datasets used to inform this analysis either did not distinguish between land use types (Lewiston Levee Reports) or defined slightly different land use categories (Puget Sound Toxics Report and Western Washington Report), EPA first needed to aggregate the datasets by similar land use categories prior to calculating the expected focal pollutant concentration in stormwater runoff from each of the five land use types.

The pollutant concentration data found in the Lewiston Levee Reports (Section 5.1.1) were used to calculate pollutant concentrations in runoff from all land use types except for open space, which was due to the fact that the report did not distinguish which land uses contributed to the monitored runoff.

The Puget Sound Toxics Report (Section 5.1.2) categorized data as coming from commercial/industrial land use, residential land use, forest/field/other land use, and agricultural land use. The agricultural land use data was not used in EPA's analysis. Monitored pollutant concentrations from the commercial/industrial land use were used to determine pollutant concentrations from both commercial and industrial land uses. Pollutant concentrations from the residential land use were used to calculated both low density residential and high-density residential pollutant concentrations. Finally, forest/field/other was used in the open space land use calculations.

The Western Washington Report (Section 5.1.3) included data from low density residential, high density residential, commercial, and industrial land uses, the same categories as found in the Lewiston Plan.

EPA aggregated similar land use types found in the three reports into five datasets where each dataset contained the concentration data of one land use type. For example, the new dataset for low density residential land use includes all the data from the Lewiston Levee Reports, only the residential data from the Puget Sound Toxics Report, and only the low-density residential data from the Western Washington Report.

A summary of these aggregated datasets, corresponding to a particular land use, is provided in Table 5.4, below.

***Table 5.4. Comparison of Datasets Used to Estimate EoP Focal Pollutant Concentrations in Runoff from Different Land Use Types.***

| Aggregated Datasets | Lewiston Levee Reports Data Used | Puget Sound Toxics Report Data Used | Western Washington Report Data Used |
|---|---|---|---|
| **Low Density Residential includes:** | All | Residential | Low density residential |
| **High Density Residential includes** | All | Residential | High density residential |
| **Commercial includes** | All | Commercial/Industrial | Commercial |
| **Industrial includes** | All | Commercial/Industrial | Industrial |
| **Open Space includes** | None | Forest/Field/Other | None |

EPA then calculated the expected focal pollutant concentration in runoff from each of the land use types by compiling datasets as summarized in Table 5.4. It should be noted that source data (Sections 5.1.1, 5.1.2, and 5.1.3) contained a different number of data points as well as data points labeled as non-detect. To address this, EPA first limited the data to the maximum value given in each report for a given parameter and substituted the non-detect value with the MRL prior to calculating the geometric mean across the data, which resulted in the expected focal pollutant concentration value. Given the inherent differences of each report, it is appropriate to use the geometric mean so as not to bias any report over the others. The general equation to calculate the end-of-pipe concentration for parameter (X) from land use (Y) is:

$$X_Y = \sqrt[n]{maximum(X_Y)_{LL} * maximum(X_Y)_{PS} * maximum(X_Y)_{WW}}$$

Where *n* represents the number of data points (alternatively, the number of reports with data for the parameter of interest), *LL* represents the Lewiston Levee Reports, *PS* represents the Puget Sound Toxics Report, and *WW* represents the Western Washington Report.

For example, the LDR dataset included the following three points for total mercury (THg): Non-detect (Lewiston Levee Reports), 0.0147 µg/L (Puget Sound Toxics Report), and 0.2 µg/L (Western Washington Report). The non-detect from the Lewiston Levee Reports was substituted with the MRL provided by that report, which was 0.2 µg/L. EPA then calculated the geometric mean of these three values to arrive at an expected end-of-pipe THg concentration of 0.084 µg/L for the LDR land use.

This process was repeated for every parameter and land use (Table 5.5). As noted previously, not every parameter for a given land use included data from all three reports.

***Table 5.5. Estimated focal pollutant concentration (ug/L) in runoff from specific land use types.***

| | Focal Pollutant | LDR | HDR | COM | IND | OPEN |
|---|---|---|---|---|---|---|
| **Metals/Metalloids** | Aluminum, dissolved | 252[c] | 252[c] | 163[c] | 163[c] | 697 |
| | Antimony, dissolved | 0.40[d] | 0.40[d] | 0.40[d] | 0.40[d] | 0.00 |
| | Arsenic, dissolved | 2.73 | 4.41[c] | 1.57 | 3.02[c] | 0.61 |
| | Barium, dissolved | 42.1[c] | 42.1[c] | 33.1[c] | 33.1[c] | 28.5 |
| | Beryllium, dissolved | 0.05[c] | 0.05[c] | 0.05[c] | 0.05[c] | 0.10 |
| | Cadmium, dissolved | 0.10 | 0.07 | 0.20 | 0.24 | 0.02 |
| | Chromium, dissolved | 1.17[d] | 1.17[d] | 1.17[d] | 1.17[d] | 0.00 |
| | Cobalt, dissolved | 0.60[c] | 0.60[c] | 0.44[c] | 0.44[c] | 1.48 |
| | Copper, dissolved | 5.75 | 7.27 | 11.47 | 6.86 | 3.95 |
| | Iron, dissolved | 6620[d] | 6620[d] | 6620[d] | 6620[d] | 0.00 |
| | Lead, dissolved | 1.09 | 1.17 | 3.44 | 1.81 | 0.48 |
| | Manganese, dissolved | 261[c] | 261[c] | 151[c] | 151[c] | 337 |
| | Mercury, total | 0.08 | 0.09 | 0.09 | 0.06 | 0.04 |
| | Nickel, dissolved | 2.37[c] | 2.37[c] | 2.28[c] | 2.28[c] | 2.37 |
| | Selenium, dissolved | 2.00[c] | 2.00[c] | 2.00[c] | 2.00[c] | 0.50 |
| | Silver, dissolved | 0.02[d] | 0.02[d] | 0.02[d] | 0.02[d] | 0.00 |
| | Thallium, dissolved | 0.03[c] | 0.03[c] | 0.03[c] | 0.03[c] | 0.10 |
| | Titanium, dissolved | 28.6[d] | 28.6[d] | 28.6[d] | 28.6[d] | 0.00 |
| | Vanadium, dissolved | 45.4[d] | 45.4[d] | 45.4[d] | 45.4[d] | 0.00 |
| | Zinc, dissolved | 38.7 | 96.5 | 125.8 | 76.9 | 10.0 |
| **PAHs** | 1-Methylnaphthalene | 0.03[a] | 0.03[a] | 0.29[a] | 0.22[a] | 0.01 |
| | 2-Methylnaphthalene | 0.23 | 0.31 | 1.06 | 0.96 | 0.01 |
| | Acenaphthene | 0.23 | 0.23 | 0.56 | 0.15 | 0.01 |
| | Acenaphthylene | 0.23 | 0.14 | 0.56 | 0.15 | 0.01 |
| | Anthracene | 0.33 | 0.21 | 1.01 | 0.13 | 0.01 |
| | Benz(a)anthracene | 0.26 | 0.27 | 1.44 | 0.43 | 0.01 |
| | Benzo(a)pyrene | 0.44 | 0.39 | 1.69 | 0.49 | 0.03 |
| | Benzo(b)fluoranthene | 0.43 | 0.28 | 2.04 | 0.40 | 0.01 |
| | Benzo(g,h,i)perylene | 0.42 | 0.34 | 1.83 | 0.57 | 0.01 |
| | Benzo(k)fluoranthene | 0.40 | 0.25 | 1.40 | 0.28 | 0.01 |
| | Chrysene | 0.48 | 0.38 | 2.11 | 0.64 | 0.01 |
| | Dibenzo(a,h)anthracene | 0.66 | 0.50 | 0.82 | 0.11 | 0.02 |
| | Fluoranthene | 0.51 | 0.49 | 2.95 | 0.78 | 0.01 |
| | Fluorene | 0.11 | 0.24 | 0.54 | 0.28 | 0.01 |
| | Indeno(1,2,3-cd)pyrene | 0.50 | 0.42 | 1.77 | 0.54 | 0.02 |
| | Naphthalene | 0.40 | 0.38 | 1.11 | 1.09 | 0.02 |
| | Phenanthrene | 0.26 | 0.31 | 1.95 | 0.53 | 0.01 |
| | Pyrene | 0.49 | 0.45 | 2.76 | 0.84 | 0.02 |

***Source Data:*** Unless otherwise noted using the nomenclature below, the data reported is the geometric mean across all three datasets.
[a]Western Washington Report + Puget Sound Toxics Report
[b]Lewiston Levee Reports, Western Washington Report, and Puget Sound Toxics Report
[c]Lewiston Levee Reports + Puget Sound Toxics Report
[d]Lewiston Levee Reports
[e]Puget Sound Toxics Report

### 5.2.3 End-of-Pipe Pollutant Concentrations

Pollutant concentrations in runoff can vary greatly depending on land use type. To develop a weighted pollutant concentration across land use types within a basin, the following equation was used:

$$C_{weighted} = C_{LDR} * a_{LDR} + C_{HDR} * a_{HDR} + C_{COM} * a_{COM} + C_{IND} * a_{IND} + C_{OPEN} * a_{OPEN}$$

Where:

$C_{weighted}$ = expected EoP pollutant concentration $C$ for an entire drainage area
$C_x$ = expected pollutant concentration for land use $x$ (see Table 5.5)
$a_x$ = percentage of land use $x$ within the basin (see Table 5.3)

The following provides an example of calculating the EoP concentration for dissolved aluminum with Basin #7 (21st Street/Thain Road).

As described previously, Basin #7 is composed of three sub-basins (A, B, and C) and LDR, HRD, and COM land use types. The percentages of each land use within the basin are:

$$a_{LDR} = 43.5\% \quad a_{HDR} = 28.8\% \quad a_{COM} = 27.6\%$$

The concentration of dissolved aluminum for each land use is the geometric mean of the maximum reported concentrations in the Lewiston Levee Report, Puget Sound Toxics Report, and Western Washington Report.

$$C_{LDR} = 251.68\ \mu g/L \quad C_{HDR} = 251.68\ \mu g/L \quad C_{COM} = 163.16\ \mu g/L$$

Using these values in the weighted concentration equation given above:

$$C_{weighted} = (251.68 * 43.5\%) + (251.68 * 28.8\%) + (163.16 * 27.6\%)$$

$$Dissolved\ Aluminum_{Basin\ \#7} = 227\ \mu g/L$$

This process was repeated for each pollutant in every basin (excluding Basins #16 and #17).

### 5.2.4 Prediction of Pollutant Loadings

End-of-pipe mass loadings were calculated for a subset of pollutants during two discreet storm events to provide a snapshot in time of a typical MS4 discharge. To calculate mass loadings, the Soil Conservation Service (SCS) Curve Number Method (USDA, 1986) was used to calculate the volume of runoff from a drainage area during a storm event. The SCS Curve Number Method relies on inputs of precipitation, hydrologic soil group, basin size, and land use to determine a Curve Number (CN) and calculate runoff volume.

As stated in *Urban Hydrology for Small Watersheds Technical Release 55* (TR-55) published by U.S. Department of Agriculture in 1986:

> *"The model described in TR-55 begins with a rainfall amount uniformly imposed on the watershed over a specified time distribution. Mass rainfall is converted to mass runoff by using a runoff curve number (CN). CN is based on soils, plant cover, amount of impervious areas, interception, and surface storage."*

The two-year six-hour and two-year 24-hour storms are the rainfall amount over a specified time distribution mentioned in TR-55. Following the Soil Conservation Service (SCS; now the Natural Resources Conservation Service) Curve Number Method (as described in TR-55), precipitation data for the two-year six-hour and two-year 24-hour storms were used to calculate runoff volume from each drainage basin.

The SCS runoff equation is:

$$Q = \frac{(P - I_a)^2}{\left((P - I_a) + S\right)}$$

Initial abstraction ($I_a$) is all losses before runoff begins including; water retained in surface depressions, water intercepted by vegetation, evaporation, and infiltration. Initial abstraction is highly variable but is generally correlated with soil and cover parameters. In a first flush scenario initial abstraction would be greater than other times of the year due to increased infiltration capacity. TR-55 states that initial abstraction was found to be approximated by the following empirical equation:

$$I_a = 0.2 * S$$

Additionally, TR-55 explains that *S* is related to the soil and cover conditions of the watershed through the SCS Runoff Curve Number. CNs range from 0 to 100, and *S* is related to *CN* by:

$$S = \frac{1000}{CN} - 10$$

Using the relationships described by TR-55 it is possible to estimate runoff ($Q$) from land use Y, using rainfall ($P$) and *CN* (of land use Y) with the following equation:

$$Q_Y = \frac{\left[P - 0.2 * \left(\frac{1000}{CN_Y} - 10\right)\right]^2}{\left\{\left[P - 0.2 * \left(\frac{1000}{CN_Y} - 10\right)\right] + \left(\frac{1000}{CN_Y} - 10\right)\right\}}$$

The estimated runoff ($Q$) can then be used, along with the expected EoP pollutant concentrations for each land use and the land use area within the drainage basin to calculate the EoP mass loading using the following equation:

$$M_{weighted} = \Big((C_{LDR} * a_{LDR} * Q_{LDR}) + (C_{HDR} * a_{HDR} * Q_{HDR}) + (C_{com} * a_{com} * Q_{com}) + (C_{ind} * a_{ind} * Q_{ind}) + \left(C_{open} * a_{open} * Q_{open}\right)\Big) * Area_{Basin}$$

The following provides an example calculation to estimate loading of dissolved copper in runoff from Basin #7 (which is comprised of three land use types) during the two-year, twenty-four-hour storm. As noted previously, the CN of each land use was provided in the Lewiston Plan and EPA estimate the land use types within each Basin as a percentage in Section 5.2.1. For this example, the following information is known or was previously calculated:

$$CN_{LDR} = 75 \quad CN_{HDR} = 85 \quad CN_{com} = 92$$

$$P_{2yr-24hr} = 1.21\ inches \quad Area_{Basin\ 7} = 1{,}519\ acres$$

$$a_{LDR} = 43.5\% \quad a_{HDR} = 28.8\% \quad a_{COM} = 27.6\%$$

$$C_{LDR} = 5.75\ \mu g/L \quad C_{HDR} = 7.27\ \mu g/L \quad C_{COM} = 11.47\ \mu g/L$$

The runoff ($Q$) for each land use type can be calculated by substituting this information into the equation presented above:

$$Q_{LDR} = \frac{\left[1.21 - 0.2 * \left(\frac{1000}{75} - 10\right)\right]^2}{\left\{\left[1.21 - 0.2 * \left(\frac{1000}{75} - 10\right)\right] + \left(\frac{1000}{75} - 10\right)\right\}} = 0.076\ inches$$

Using this same equation for HDR and COM land use types results in the following expected runoff values:

$$Q_{HDR} = 0.28\ inches \quad Q_{COM} = 0.56\ inches$$

Together, this information can be used in the EoP mass loading equation provided above to calculate the estimated loading of dissolved copper in runoff from Basin #7:

$$M_{Cu,dissolved} = \Big[\big((5.75\ \mu g/L * 43.5\% * 0.076in) + (7.27\ \mu g/L * 28.8\% * 0.28in) + (11.47\ \mu g/L * 27.6\% * 0.56in)\big) * 1{,}519ac\Big] * \left(\frac{102{,}709L}{ac - in} * \frac{2.2 * 10^{-9} lbs}{1\mu g}\right)$$

$$dissolved\ Copper_{Basin\ \#7} = 0.926\ pounds$$

This equation includes two necessary unit conversations to convert micrograms (µg) to pounds (lbs) and liter ($L$) to acre-inches (ac-in).

This process was repeated for a subset of the focal pollutants in every basin (excluding basins #16 and #17) for both storm events. Most basins in Lewiston drain to a common point before being discharged through an outfall, like the West Levee Pond Pump Station, or drain directly into a common receiving water, like the Snake River. Estimated end-of-pipe loadings for each parameter were aggregated into larger basins based on the information presented in Table 5.6 and also depicted in Figure 5.1, below.

***Table 5.6. Summary of which basins drain to a common point.***

| Aggregated Basin Name | Lewiston Basins | Color in Figure 5.1 | |
|---|---|---|---|
| Lindsay Creek Pond and Drainage Tunnel | 1, 2, 3, 4, 6, 19 | Green | |
| 380 Structure Drainage Tunnel | 7 | Red | |
| Direct Discharges to Snake River | 5, 8, 9, 10, 11, 20 | Gray | |
| West Levee Pond | 12, 13, 14 | Blue | |
| North Levee Pond | 15, 16, 17, 18 | Orange | |

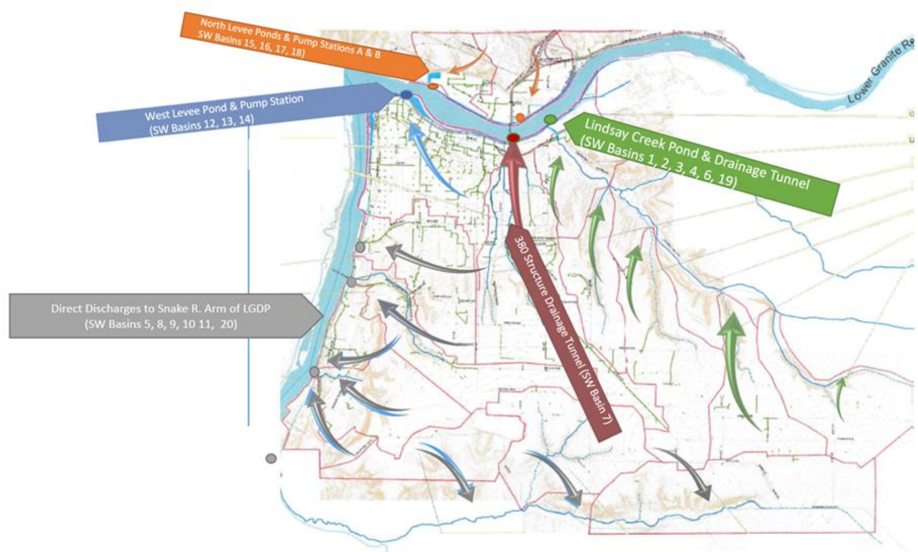


***Figure 5.1. Map depicting which basins drain to a common point.***

The following provides an example of aggregating estimated end-of-pipe pollutant loadings for dissolved Copper from the West Levee Pond.

The West Levee Pond Basin is made up of basins #12, 13, and 14. Using the approach described above, the following dissolved copper loadings were estimated for each basin:

$$M_{basin\#12} = 0.09lbs \quad M_{basin\#13} = 0.36lbs \quad M_{basin\#14} = 0.11lbs$$

Therefore, the estimated end-of-pipe total loading from the West Levee Pond Basin for the 2-year, 24-hour storm event is:

$$M_{west\ levee\ pond\ basin} = M_{basin\#12} + M_{basin\#13} + M_{basin\#14}$$

$$M_{west\ levee\ pond\ basin} = 0.09lbs + 0.36lbs + 0.11lbs$$

$$dissolved\ copper_{west\ levee\ pond\ basin} = 0.57\ lbs$$

### 5.2.5 Dilution

It was not possible to predict receiving water concentrations of pollutants from permitted stormwater outfalls within the Action Area given limited modeling tools and information regarding outfall locations, pipe sizing, and pipe geometry. Therefore, EPA selected a range of dilution factors to represent the surface water concentrations of pollutants transported from the point of discharge. Receiving water concentrations were analyzed using predicted EoP concentrations and 0.1X, 0.01X, and 0.001X dilution levels.

## 5.3 TOXICITY ASSESSMENT

EPA considered the effects to ESA-listed species and their prey from exposure to focal pollutants associated with stormwater within the Action Area. This hazard analysis focused on exposure to focal pollutants in the water column during stormwater discharge, which occurs when ESA-listed salmonids are migrating and overwintering in the Clearwater and Snake Rivers.

The discussion of the toxicity assessment methods is presented in the following sections. Section 5.3.1. describes the literature search conducted to ensure that we were using the best scientific and commercial data available; Section 5.3.2 describes how we evaluated the toxicity data obtained in the literature search to ensure it met test acceptability requirements; Section 5.3.3 describes how the effect levels were calculated when limited data were available, and the equilibrium partitioning method used for PAHs; Section 5.3.4 describes the statistical process used to calculate the low-effect levels for prey species; Sections 5.3.5 and 5.3.6 describes the method for characterizing the potential risk using conservative screening and reasonable worst-case scenario approaches for ESA-listed salmonids and their prey, respectively.

### 5.3.1 Literature Search

EPA relied primarily on the nine water quality criteria and standards that have undergone ESA consultation recently both nationally and in Idaho, as well as other EPA approved screening benchmarks (Table 5.7). EPA included the three Idaho Water Quality Standards generated through Reasonable and Prudent Alternatives (RPAs) (i.e. copper, mercury, and selenium) presented in the Services' biological opinions (USFWS, 2015b; and NMFS, 2014, NMFS, 2015). EPA conducted a literature search for the remaining focal pollutants that have not gone through ESA consultation to obtain acute and chronic toxicity. Aluminum was addressed using a separate process associated with the most recently updated Water Quality Criterion (WQC) for that metal.

The quantity and quality of toxicity data available for focal pollutants varies widely. For some stormwater pollutants many toxicity studies were available, while others may have only one or a few published toxicity studies. In some studies, potential toxicity to listed species was examined (Steelhead [rainbow trout] and Chinook), while other studies evaluated toxicity in non-listed salmonids or non-salmonid aquatic species.

***Table 5.7. Effect Levels for Stormwater Pollutants Selected to for the Tier I Assessment of Toxicity to Salmonids (Chinook Salmon, Steelhead, Sockeye and Bull Trout).***

| Focal Pollutant | Effect | Endpoint | Species | Source |
|---|---|---|---|---|
| Aluminum (t) | Chronic | EC15, EC10, EC5 | Multiple salmonids | USEPA, 2020 |
| Antimony (t) | Growth | MATC | Fathead Minnow | Kimball, 1978 |
| Arsenic[b] (d) | Chronic | CCC | Multiple | Idaho WQC |
| Barium | Mortality | NOEC | Rainbow Trout | EPA, EFED 1992 |
| Beryllium[1] (t) | Mortality | NOEC | Fathead Minnow | Kimball, 1978 |
| Cadmium[c] (d) | Chronic | CCC | Multiple | Idaho WQS |
| Chromium III (d) | Chronic | CCC | Multiple | Idaho WQS |
| Cobalt (d) | Chronic | FCV[d] | Multiple | Stubblefield et al. 2020 |
| Copper (d) | Chronic | CCC | Multiple | BLM-based (10%ile) Idaho WQS |
| Iron (t) | Growth | EC20 | Mountain Whitefish (*Prosopium williamsoni*) | Cadmus et al., 2018 |
| Lead (d) | Chronic | CCC | Multiple | Idaho WQS |
| Manganese (d) | growth and mortality | IC25 | Brown Trout (*Salmo trutta*) | Stubblefield et al. 1997 |
| Mercury[b] (t) | Chronic | CCC | Multiple | Idaho WQS RPA |
| Nickel (d) | Chronic | CCC | Multiple | Idaho WQS |
| Selenium (d) | Chronic | CCC | Multiple | Idaho WQS RPA based on fish Tissue |
| Silver | Acute | CMC | Multiple | Idaho WQS |
| Thallium (t) | Mortality | LC50 | Rainbow Trout | Horne et al. 1983 |
| Titanium (d) | Behavioral (swimming speed) | NOEC | Rainbow Trout | Boyle et al, 2013 |
| Vanadium[1] (t) | Mortality | NOEC | Chinook | Hamilton and Buhl, 1990 |
| Zinc (d) | Chronic | CCC | Multiple | Idaho WQS |
| PAHs | Chronic | FCV[d] | Multiple | EPA 2003 |

[a] Generated using multilinear regressions models to normalize the available toxicity data to accurately reflect the effects of the water chemistry (pH, DOC, total hardness) on the toxicity of aluminum to tested species.

[b] RPA Idaho Toxics Bio Op (human health criterion)

[c] Calculated using the minimum hardness of 10 mg $CaCO_3$/L per the Idaho WQS

[d] Final Chronic Value (FCV) protective of survival, growth, and reproduction developed using EPA's approach for deriving water quality criteria and the Equilibrium Partitioning Approach (EPA 2003)

[c] Calculated using the minimum hardness of 7 mg $CaCO_3$/L for the Clearwater River per the Idaho WQS

MATC: Maximum acceptable toxic concentration

NOEC: No observable effect concentration

[1] Calculated by dividing the LC50 /Acute to Chronic Ratio (ACR) using the ACR = 8.6

To evaluate aluminum in the stormwater discharge, EPA utilized the toxicity data and methodology used to generate final 2018 recommended national criteria. EPA published revised 304(a) aquatic life criteria for aluminum in freshwater in December 2018.[7] The criteria were part of a Federal Rulemaking to promulgate aluminum criteria in Oregon. Instantaneous aluminum water quality criteria are generated using an aluminum criteria calculator and site-specific water quality characteristics.[8] ESA consultation conducted as part of the rulemaking resulted in Biological Opinions provided by the Services in 2020 (NMFS, 2020b; USFWS, 2019). The criteria were determined likely to adversely affect salmonids but would not jeopardize their continued existence. These criteria are based upon Multiple Linear Regression (MLR) models for fish and invertebrate species that use pH, dissolved organic carbon (DOC), and total hardness to quantify the effects of these water chemistry parameters on the toxicity of aluminum to aquatic organisms. The MLR models are used to normalize the available toxicity data to accurately reflect the effects of the water chemistry (pH, DOC, total hardness) on the toxicity of aluminum to tested species and to calculate instantaneous water quality criteria.

The water quality data EPA used for the MS4 consultation to generate the model outputs for aluminum were the same data used to generate the BLM-based copper criteria for this consultation. EPA used data from the NWIS Station 13342500 (Clearwater River at Spalding) collected between 1973 and 1998. Toxicity data, as summarized in EPA 2020, were used for this assessment to generate the range of water chemistry normalized salmonid low effect levels (SLELs) and prey category low effect levels (PCLELs) (Table 5.8 and Table 5.9) at the site. Because there were multiple water quality samples collected over time with which to generate the ranges of effect concentrations ($EC_x$s) for salmon and bull trout, there are separate tables presenting the results for aluminum throughout this section.

For the normalization procedure, EPA used the vertebrate MLR equation to calculate $EC_{10}$ and $EC_{05}$ values for the genus *Oncorhynchus* and *Salvelinus* for each paired water chemistry sample within this data set. The taxonomic adjustment factor (TAF) 1.976 was used to adjust the $LC_{50}$ to the $LC_5$ for both salmon and bull trout. Three TAFs were used to adjust the $EC_{20}$ to $EC_{15}$, $EC_{10}$ and $EC0_5$ values, including 1.115, 1.316 and 1.696, respectively for both salmon and bull trout. TAFs were calculated by dividing high effects concentrations ($LC_{50}$ or $EC_{20}$) by low effects concentrations ($LC_{05}$ or $EC_{05}$) that were obtained from concentration-response (C-R) curves from toxicological studies conducted in surrogate fish species. Further methods information can be found in (EPA,2020).

The aluminum calculator also uses site specific water quality data to generate the species genus means acute and chronic values (GMAV, GMCV) for both vertebrate and invertebrate species. EPA used the lowest GMAV for invertebrates (3,935 µg/L)) as the PCLEL to assess the potential for a reduction in ESA-Listed salmonid prey potentially exposed to aluminum in the stormwater discharges (Table 5.9).

[7] https://www.epa.gov/wqc/aquatic-life-criteria-aluminum
[8] https://www.epa.gov/wqc/2018-final-aquatic-life-criteria-aluminum-freshwater

***Table 5.8. Aluminum Chronic Effect Values generated using Multilinear Regression and Taxonomic Adjustment Factors for Salmon and Bull Trout based on Clearwater River Water quality Data.***

| **SALMON** | | | **BULL TROUT** | | |
|---|---|---|---|---|---|
| **$EC_{15}$ (µg/L)** | **$EC_{10}$ (µg/L)** | **$EC_{05}$ (µg/L)** | **$EC_{15}$ (µg/L)** | **$EC_{10}$ (µg/L)** | **$EC_{5}$ (µg/L)** |
| 562.6 | 480.9 | 373.2 | 681.8 | 582.9 | 452.4 |
| 475.4 | 406.4 | 315.4 | 576.2 | 492.6 | 382.3 |
| 543.6 | 464.7 | 360.6 | 658.9 | 563.3 | 437.2 |
| 278.1 | 237.8 | 184.5 | 337.1 | 288.2 | 223.7 |
| 520.5 | 445 | 345.3 | 630.9 | 539.3 | 418.6 |
| 586.9 | 501.7 | 389.3 | 711.3 | 608.1 | 472 |
| 327.1 | 279.6 | 217 | 396.4 | 338.9 | 263 |
| 813.1 | 695.1 | 539.4 | 985.5 | 842.5 | 653.9 |
| 212.7 | 181.9 | 141.1 | 257.8 | 220.4 | 171.1 |
| 486.7 | 416 | 322.8 | 589.8 | 504.2 | 391.4 |
| 932.7 | 797.3 | 618.7 | 1130.4 | 966.4 | 750.1 |
| 676.5 | 578.3 | 448.8 | 819.9 | 700.9 | 544.1 |
| 694.3 | 593.6 | 460.6 | 841.5 | 719.4 | 558.4 |
| 707 | 604.4 | 469 | 856.8 | 732.5 | 568.6 |
| 323.4 | 276.4 | 214.5 | 391.9 | 335 | 260.1 |
| 369.7 | 316.1 | 245.3 | 448.1 | 383.1 | 297.3 |
| 767.8 | 656.4 | 509.3 | 930.5 | 795.5 | 617.5 |
| 653.9 | 559 | 433.8 | 792.5 | 677.5 | 525.9 |
| 737.3 | 630.3 | 489.1 | 893.6 | 763.9 | 593 |
| 1531.4 | 1309.2 | 1015.9 | 1856.1 | 1586.7 | 1231.6 |
| 703.3 | 601.2 | 466.6 | 852.4 | 728.7 | 565.6 |
| 393.9 | 336.7 | 261.3 | 477.4 | 408.1 | 316.8 |
| 1064.5 | 910 | 706.2 | 1290.2 | 1102.9 | 856.1 |
| 839.5 | 717.6 | 556.9 | 1017.4 | 869.8 | 675.1 |
| 850.3 | 726.9 | 564.1 | 1030.6 | 881 | 683.8 |
| 926.1 | 791.7 | 614.4 | 1122.4 | 959.6 | 744.8 |
| 936.4 | 800.5 | 621.2 | 1134.9 | 970.2 | 753.1 |
| 661 | 565.1 | 438.5 | 801.2 | 684.9 | 531.6 |
| 966.3 | 826.1 | 641.1 | 1171.2 | 1001.2 | 777.2 |
| 643.9 | 550.5 | 427.2 | 780.4 | 667.2 | 517.8 |
| 510.1 | 436.1 | 338.4 | 618.3 | 528.5 | 410.2 |
| 532.7 | 455.4 | 353.4 | 645.7 | 552 | 428.4 |
| 537.3 | 459.3 | 356.5 | 651.2 | 556.7 | 432.1 |
| 947.5 | 810 | 628.6 | 1148.4 | 981.7 | 762 |

***Table 5.9. Genus Mean Chronic Values Calculated for Invertebrate Prey of ESA-Listed Salmonids based on Site-Specific Water Quality Data using the Aluminum Calculator***

| Acute Ranked GMCV | GMAV (µµg/L) | Genus | Organism |
|---|---|---|---|
| 8 | 34,720 | Aeolosoma | Invert |
| 7 | 8,630 | Chironomus | Invert |
| 6 | 5,990 | Brachionus | Invert |
| 5 | 5,279 | Lymnaea | Mollusk |
| 4 | 2,348 | Hyalella | Invert |
| 3 | 2,000 | Ceriodaphnia | Invert |
| 2 | 1,737 | Lampsilis | Mollusk |
| 1 | 1,668 | Daphnia | Invert |

EPA's ECOTOX Knowledgebase was queried for relevant toxicity tests. The download from the query was filtered according to relevant study considerations and those toxicity tests that met the considerations were reviewed to ensure that each met strict study acceptability criteria (see Section 5.3.2) prior to selecting the acute and chronic toxicity values to be used to assess the hazard to ESA-listed salmonids and their prey.

When data for ESA-listed salmonids were unavailable, EPA relied on studies using surrogate species. EPA obtained surrogate toxicity data at the most phylogenetically related taxonomic-level possible to account for the anatomical and physiological traits conserved across taxa that influence species and taxa acute and chronic sensitivity to a pollutant. For instance, the rainbow trout (*Oncorhynchus mykiss*) was the surrogate species utilized for most salmonids for most metals. Steelhead trout are the anadromous form of rainbow trout and are genetically identical, and thus rainbow trout data represents steelhead trout for the purposes of this analysis. In many cases, the species with the least genetic distance from pacific salmon species were rainbow trout, in some cases we relied on species from a different family (Table 5.7).

To focus the ECOTOX search on relevant prey species EPA reviewed the diet, life stage and habitat use of each ESA-listed salmonid in the Action Area. Table 5.10 presents the prey categories used to select appropriate toxicity tests to evaluate the potential for a reduction in prey as an adverse effect.

***Table 5.10. Categories of Prey for Listed Species***

| ESA-Listed Fish | Crustaceans | Invertebrates | Fish |
|---|---|---|---|
| Chinook Salmon | X | X | |
| Steelhead | X | X | X |
| Bull Trout | X | X | X |
| Sockeye | X | X | |

### 5.3.2 Acceptable Toxicity Data

To ensure that the highest quality studies were selected for review, test acceptability criteria from EPA's Office of Water was used to determine if a study is acceptable for use in deriving aquatic life criteria. After selecting the appropriate study, it was reviewed against the test acceptability criteria below:

1. The toxic effects are related to single chemical exposure;
2. There is a biological effect on live, whole organisms or in vitro preparation including gene chips or omics data on adverse outcome pathways potentially of interest;
3. Chemical test concentrations are reported;
4. There is an explicit duration of exposure;
5. Toxicology information that is relevant to survival, reproduction and growth effects;
6. The paper is published in the English language;
7. The paper is available as a full article (not an abstract);
8. The paper is publicly available;
9. The paper is the primary source of the data;
10. A calculated endpoint is reported or can be calculated using reported or available information;
11. Treatment(s) (minimum of three different treatments or concentrations is the minimum, no limit on the maximum number of treatments) are compared to an acceptable control;
12. The location of the study (e.g., laboratory vs. field) is reported;
13. The tested species is reported (with recognized nomenclature).

For all focal stormwater pollutants, the study with the lowest $LC_{50}$, LOEC and $EC_{50}$ or highest NOEC and MATC meeting the criteria above was selected for use.

Available empirical toxicity data for individual PAHs is generally insufficient to permit derivation of low effect levels for these compounds. This lack of data limits or precludes the ability to obtain low effect levels from the empirical procedure of criteria derivation. Therefore, to derive surface water concentrations for PAHs the equilibrium partitioning (EqP) approach for sediments was used. It should be noted that PAHs were not detected above MRLs in Steevens et al. (2005b) however, some PAH MLRs were above EqP generated effect levels, therefore we included those specific PAHs in this analysis. Section 5.3.4 presents a detailed discussion of the EqP methodology and use in this BE.

### 5.3.3 Acute and Chronic Value Derivation

The ECOTOX search for stormwater focal pollutants (Table 5.1) focused on the collection of toxicity test data for ESA-listed fish and their prey. The process for deriving the acute and chronic low effect levels differed for these ESA-listed salmonids and their prey species as described in the following sections. The ECOTOX search for stormwater focal pollutants focused on the collection of toxicity test data for salmonids and their prey. The acute and chronic values from the literature were compiled and used in a conservative approach to assess the hazard from exposure to concentrations of focal stormwater pollutants in the Clearwater River and Snake River.

EPA compiled acute and chronic effect levels for ESA-listed salmonids and surrogate fish for 19 focal pollutants prioritizing toxicity tests using salmonid species (Table 5.7 and Table 5.11). More than half of water quality standards for stormwater focal pollutants had been consulted on previously and so final chronic values (FCV) could be obtained. The remaining focal pollutant SLELs were either obtained from toxicity tests using salmonids, including rainbow trout, brown trout and Chinook or surrogate species including fathead minnows (*Pimphales promelas*) and mountain whitefish (*Prosopium williamsoni*).

In order to conduct a conservative analysis, EPA prioritized obtaining chronic studies with sublethal endpoints for salmonid species. EPA queried the ECOTOX Knowledgebase for chronic studies with sublethal effects (chronic NOEC or $EC_{20}$s) for growth, reproduction and behavior[9]. While these studies are not common, limited data do exist. Those studies that met the test acceptability criteria with the highest NOEC for growth, reproduction or behavior were used preferentially as the low-effect levels for all salmonids.

When no salmonid NOECs were found, but 96-hour $LC_{50}$s for one or more salmonids was identified, the NOEC was predicted using an acute to chronic ratio (ACR) if available from the toxicity test. This was done by dividing the 96-hour $LC_{50}$ by the chemical specific ACR to directly estimate the chronic NOEC. If an ACR was not available for the chemical from the toxicity test, the ACR developed by Raimondo et al. (2007) was applied. Raimondo et al. (2007) determined a geometric mean ACR of 8.3 from a data set of 456 same-species pairs of acute and maximum acceptable toxicant concentrations for metals, narcotics, pesticides, and other organic chemicals.

Because EPA was not able to obtain toxicity test data unique to each individual ESA-listed salmonid species (except aluminum), the SLELs and FCV pertain to all the ESA-listed salmonids evaluated in this BE (Table 5.11).

[9] Specifically, whether the behavioral endpoint could be attributed to a growth, reproduction, or survival endpoint.

***Table 5.11. Selected Low Effect Levels Concentrations for ESA-listed Salmonids (SLEL) for Prey (PCLEL) and Final Chronic Values for both Salmonids and Prey categories for each Focal Pollutant.***

| Chemical Class | Focal Pollutant | WQC/WQS or FCV[1] (µg/L) | ESA-Listed Salmonids[2] (SLEL) (µg/L) | Prey Category (PCLEL) (µg/L) | | |
|---|---|---|---|---|---|---|
| | | | | Crustaceans | Fish | Invertebrates |
| Metals/Metalloids | Aluminum (D) | See Table 5.8 | | **See** Table 5.9 | | |
| | Antimony (T) | | 3220 | | 2.0 | |
| | Arsenic (D) | 10 | | | | |
| | Barium | | 14900 | | 7462 | |
| | Beryllium[1] (T) | | 2133 | | | 17 |
| | Cadmium (D) | 0.15 | | | | |
| | Chromium $^{+3}$ (D) | 74 | | | | |
| | Cobalt (D) | 7.13 | | | | |
| | Copper (D) | 2.68[4] | | | | |
| | Iron (T) | | 1318 | 480 | 520 | 7863 |
| | Lead (D) | 0.5 | | | | |
| | Manganese (D) | | 4670 | | | 98.4 |
| | Mercury (T) | 0.002 | | 0.012[4] | 0.012[4] | 0.012[5] |
| | Nickel (D) | 16 | | | | |
| | Selenium (D) | 2.0 | | | | |
| | Silver (D) | 0.3 | | | | |
| | Thallium[1] (T) | | 193 | | | 6.7 |
| | Titanium (D) | | 640 | | | 243 |
| | Vanadium (T) | | 1675 | | | 25.4 |
| | Zinc(D) | 36 | | | 36 | |
| PAHs[3] | 1-Methylnaphthalene | 75.37 | | | | |
| | 2-Methylnaphthalene | 72.16 | | | | |
| | Acenaphthene | 55.85 | | | | |
| | Acenaphthylene | 306.90 | | | | |
| | Anthracene | 20.70 | | | | |
| | Benz(a)anthracene | 2.23 | | | | |
| | Benzo(a)pyrene | 0.96 | | | | |
| | Benzo(b)fluoranthene | 0.68 | | | | |
| | Benzo(g,h,i)perylene | 0.44 | | | | |
| | Benzo(k)fluoranthene | 0.64 | | | | |
| | Chrysene | 2.04 | | | | |
| | Dibenzo(a,h)anthracene | 0.28 | | | | |
| | Fluoranthene | 7.11 | | | | |

***Table 5.11. Selected Low Effect Levels Concentrations for ESA-listed Salmonids (SLEL) for Prey (PCLEL) and Final Chronic Values for both Salmonids and Prey categories for each Focal Pollutant.***

| Chemical Class | Focal Pollutant | WQC/WQS or FCV[1] (µg/L) | ESA-Listed Salmonids[2] (SLEL) (µg/L) | Prey Category (PCLEL) (µg/L) | | |
|---|---|---|---|---|---|---|
| | | | | Crustaceans | Fish | Invertebrates |
| | Fluorene | 39.30 | | | | |
| | Indeno(1,2,3-cd) pyrene | 0.28 | | | | |
| | Naphthalene | 193.50 | | | | |
| | Phenanthrene | 19.10 | | | | |
| | Pyrene | 10.11 | | | | |

**Notes:**
Except for Vanadium all focal pollutants SLELs are based on surrogate species
T: total metal
D: dissolved metal
[1]: These criteria, standards and FCV are used in the hazard assessment for both ESA-listed fish and their prey.
[2]: Includes Fall/Spring and Summer run Chinook, Snake River Sockeye, Snake River Steelhead and Columbia River bull trout.
[3]: EqP approach for deriving the FCV
[4] Criteria developed using the biotic ligand model (BLM).
[5] Chronic WQC for invertebrate prey and non-salmonid fish prey species

### 5.3.4 Derivation of Chronic Criteria for PAHs Stormwater Pollutants

The approach outlined in this assessment used to evaluate the effects of focal pollutants is different for PAHs. The available empirical toxicity data for individual PAH and phthalate compounds is generally insufficient to permit derivation of SLELs/PCLELs for these compounds. The mechanistic approach for developing chronic criteria used here is based on understanding the bioavailability of contaminants in surface water, then determining whether these bioavailable contaminants are present in sufficiently high concentrations to cause adverse effects. Within this document, the mechanistic approach used to develop FVCs for individual PAHs is EqP of nonpolar organic chemicals with a narcotic mode of toxic action between various environmental compartments. The details underlying the use of EqP and narcosis to develop the FCVs for PAHs used in the MS4 permit are presented in USEPA (2003c).

Narcosis is the most common mode of action of organic chemicals, with roughly two thirds of all organics whose modes of action are known eliciting their toxicity via narcosis. Symptoms of narcotic toxicity include decreased nervous system activity, lethargy, loss of equilibrium and ultimately death. Narcotic toxicity is reversible if the environmental concentration of the chemical is reduced below that required to elicit toxicity. Narcosis is perhaps better known as the mode of toxic action of anesthetics used in medicine.

The EqP process used here is based on EPA's methods for deriving sediment quality criteria for PAHs and other nonpolar organic compounds (USEPA, 2008 and 2003c).

This approach is used because the toxic concentration of narcotic organic chemicals in aquatic biota tissues is known and is also essentially constant when expressed on a molar basis (e.g. millimoles/kg) in either whole body tissue or in lipids of aquatic biota. As these tissue concentrations are known, they can be used to calculate chemical concentrations in water and sediment organic carbon. This ability to calculate chemical concentrations known to be toxic or nontoxic in water and sediment organic carbon from tissue data is why a mechanistic sediment quality criteria derivation approach can also be used to calculate water quality criteria.

Some important points to note, however, are that the EqP approach does not require the use of surrogate species toxicity data to derive chronic water quality criteria and separate criteria are not needed for freshwater and marine water. Specifically, any species where PAH toxicity is elicited via narcosis can serve as a surrogate species for any other species without empirical PAH toxicity data, but where the mode of action of PAH toxicity is narcosis. This is due to the constant PAH tissue contaminant concentration required to elicit toxicity in all species.

The $LC_{50}$ concentrations of chemicals in water clearly do not protect aquatic species from the toxic effects of chemicals on survival, reproduction and growth. To convert acutely toxic water concentrations to concentrations that are protective of aquatic species from adverse effects on survival, reproduction and growth, the acute $LC_{50}$ is divided by a chemical specific ACR.

The ACR is defined as the ratio of an acute toxicity value, such as the $LC_{50}$ to a chronic toxicity endpoint such as the maximum acceptable toxicant concentration (MATC, considered to be the concentration above which chronic toxicity begins to be observed). For PAH compounds, the mean ACR is 4.16 (USEPA, 2003c). This ACR of 4.16 is the mean ratio of acute to chronic toxicity for six species exposed both acutely and chronically to one or more of six individual PAHs in 15 experiments (USEPA, 2003c). This ACR is used because compared to the amount of acute toxicity data available for PAHs, the number of chronic PAH toxicity studies is small.

In the environment, chemicals are not normally found as individual compounds, but instead are found as components of a mixture of chemicals in effluents, surface water or sediments. This is particularly true for PAH compounds. Unlike most other organic chemicals, PAHs are not released in a pure or individual PAH compound form. Rather, because PAHs consist of thousands of possible structures originating from three categories of PAH sources to the environment (petrogenic, pyrogenic or diagenic), they always occur in the environment as complex mixtures.

A primary reason the USEPA (2003c) methodology for deriving PAH FCVs was selected for use is that the approach can be designed for deriving FCVs for mixtures of multiple PAH compounds in surface water. As the values (Table 5.8) are intended for use in waters containing chemical mixtures, the use of the mechanistic criteria development method employed herein for PAH compounds is appropriate.

The toxicity of mixtures of narcotic chemicals has been found to be concentration additive (Deneer et al., 1988; Hermens et al., 1984), and this additivity of individual narcotic chemical toxicity is what permits derivation of FCVs for PAH mixtures, all of whose individual components elicit their toxicity via narcosis. Concentration addition also implies that the proportion of the individual PAHs in any mixture is irrelevant to the total molar tissue concentration, and thus toxicity of PAH mixtures.

EqP can be used to calculate environmental quality benchmarks for any environmental medium, such as water quality criteria, for any toxicity endpoint (e.g. survival, reproduction, growth, behavior) for which there are tissue-only, water-only or sediment-only toxicity data. This BE uses the FCV for PAHs, which were derived using the National Water Quality Criteria (WQC) Guidelines (Stephan et al., 1985), as the toxicity endpoint for the chronic criteria for PAHs (USEPA, 2003c, Table 5.8). These values are intended to be the concentrations of a chemical in water that are protective of the survival, reproduction and growth of aquatic life.

### 5.3.5 Fish Effects Analysis

EPA used a standard deterministic ecological risk assessment (ERA) approach by developing hazard quotients (HQ) to represent the potential adverse effects of stormwater pollutants on ESA-listed salmonids (USEPA, 1998). This approach has been used in other ESA consultations for water quality standards and NPDES permitting actions.

A range of effect levels were considered depending on the available toxicity tests for relevant species. These effect levels included: no observed effect levels (NOECs); various ECx values that that effect no more than X percent of the test population (i.e. $EC_{20}$, $EC_{15}$, $EC_{10}$, $EC_{05}$); inhibition concentration that effect no more than 25 percent of the test population ($IC_{25}$); maximum acceptable toxicant concentration (MATC); and the lowest or FCV from water quality standards/criteria previously consulted on (Table 5.7 and Table 5.11).

For most focal pollutants, EPA used literature derived data. The SLEL was estimated by one of the methods presented in Section 5.3.3. The SLEL/FCV represents the lowest concentration found in scientific literature or calculated to have no measurable effect on an ESA-listed salmonid. The SLEL/FCV is specific to each focal pollutant and ESA-listed salmonid[10]. The SLEL/FCV was then compared to the predicted EPC for that pollutant, defined as the estimated or anticipated maximum concentration of a stormwater pollutant in the receiving waterbody after its discharge or release within the Action Area.

As discussed in Section 5.2, we developed three receiving water EPC estimates using a set dilution series (0.1X, 0.01X and 0.001X). Hazard quotients (HQs) were calculated for EoP concentrations and for each of the three dilution scenarios. Using the EoP concentration as the predicted EPC results in a very conservative estimate of the pollutant concentration (no dilution) in receiving waters. Thus, if the HQ calculated from this

[10] The FCV and SLEL is the same for each of the four salmonids evaluated in the BE, they are not species-specific due to the lack of species-specific toxicity data.

predicted EPC (EoP concentration) is less than 1.0, then it can be concluded that exposure to the focal pollutant is not expected to result in adverse effects. That is, it is expected that the receiving water pollutant concentration will always be less than the EoP concentration due to dilution of stormwater discharges.

HQs are calculated as followed:

$$HQ = \frac{EPC}{SLEL}$$

Where:

*HQ* = hazard quotient (unitless)

*Exposure Point Concentration (EPC)* = The predicted concentration of a stormwater pollutant (µg/L) in a receiving waterbody after it is discharged from the MS4 (Section 5.2). For purposes of this analysis, EPA evaluated pollutant concentrations at EoP and receiving water dilution scenarios of 0.1X, 0.01X, and 0.001X.

*Salmonid Low Effect Level (SLEL)* = Either the measured or estimated acute NOEC, chronic (long-term) NOEC for a threatened or endangered species; or, water quality criteria or standards that have undergone ESA consultation, in units of µg/L. In some cases, the FCV is the SLEL.

The HQs serve as one line of evidence to be used in determining the likelihood of adverse effects to ESA-listed salmonids. Consistent with the risk assessment framework, we conducted a tiered process which included a Tier I and Tier II toxicity assessment. The Tier I assessment is considered a conservative screening-level assessment intended to avoid making a Type II error (e.g. false negative). The Tier II assessment only includes those focal pollutants with an HQ>1.0 in the 0.1X dilution in the Tier I assessment. The Tier II assessment includes more realistic EPCs and species exposure assumptions in addition to the SLELs and FCVs. These Tiered assessments are described in detail below.

#### *5.3.5.a Tier I Salmonid Toxicity Assessment Approach*

As is standard in ERA, the first step is to conduct a conservative screening analysis whereby the most conservative assumptions and inputs are used to screen out pollutants that are not expected to be hazardous to ESA-listed salmonids. The remaining "focal pollutants" are then evaluated using more realistic assumptions and inputs to consider a reasonable worst-case scenario that may result in effects that are reasonably certain to occur (84 FR 44976).

Consistent with an ERA screening level process, it is important to minimize the chances of concluding that there is no risk when in fact a risk exists (prevent the occurrence of false negatives, or, Type II errors). This rapid approach uses inputs that are conservative and biased in the direction of overestimating hazard based on toxicity (or risk). This approach ensures that pollutants that are more likely to be hazardous are studied further.

Following this construct, we conducted the analysis using conservative expressions of the data (maximum exposure values and lowest toxicity values) and exposure assumptions (continual/direct exposure) to screen out focal pollutants that were not expected to result in adverse effects to ESA-listed fish directly or through a reduction in prey.

Using this screening level approach, EPA incorporated the maximum focal pollutant concentration with species exposure assumptions. We used the geometric mean of the maximum discharge concentration to calculate the EoP concentrations for each of the 20 basins within the Action Area and compared these with the SLELs, FCVs and $EC_x$s.

EPA assumed that all ESA-listed salmonids were exposed to stormwater in the Action Area. EPA then performed the following steps to conduct the Tier I hazard assessment:

1. Calculate the EoP concentrations from the geometric mean of the maximum concentration for each Basin and focal pollutant to generate all EPCs (i.e. EoP, 0.1X, 0.01X, or 0.001X dilution). See Section 5.2.
2. Calculate the HQ for each focal pollutant using the EoP concentration and SLEL/FCV/ECx for each focal pollutant in each basin;
3. If the EoP HQ is less than 1.0 in all Basins, that focal pollutant is eliminated from further consideration.
4. If the EoP HQ is greater than 1.0 in any Basin, then calculate the HQ for that focal pollutant using the 0.1X dilution concentration for each focal pollutant;
5. If the 0.1X dilution HQ is less than 1.0 in all Basins, that focal pollutant is eliminated from further consideration.
6. If the 0.1X dilution HQ is greater than 1.0 in any Basin, the focal pollutant was evaluated using the Tier II approach.

#### *5.3.5.b Tier II Salmonid Toxicity Assessment Approach*

The purpose of the Tier II assessment is to consider a reasonable worst-case scenario to gauge the likelihood of adverse effects of ESA-listed salmonids from the proposed action. While the Tier I approach is integral to avoiding a Type II error in screening focal pollutants that should be evaluated further, a more realistic consideration of the information and data are necessary to determine the likelihood for adverse effects.

The Tier II assessment was conducted for focal pollutants with a HQ>1.0 based on the Tier I assessment. The only difference between the Tier I and Tier II assessments was the use of the geometric mean of the maximum focal pollutant concentration from the three data sets evaluated.

EPA performed the following steps to conduct the Tier II hazard assessment:

1. Calculate the EoP concentration from the *geometric metric mean of all discharge concentrations* (not just maximum concentrations as was done for Tier I) for each

focal pollutant across the three datasets for each of the 20 Basins to generate all of the EPCs (i.e. EoP, 0.1X, 0.01X, and 0.001X dilution);

2. Calculate the HQ for each focal pollutant using the EoP concentration and SLEL/FCV for each focal pollutant in each basin;
3. If the EoP HQ<1.0 in all Basins, then the focal pollutant was eliminated from further consideration for that Basin;
4. If the EoP HQ>1.0 in any Basin, then calculate the HQ for the focal pollutant using the 0.1X dilution concentration;
5. If the 0.1X dilution HQ<1.0 in all Basins, that focal pollutant was eliminated from further consideration in that Basin.
6. If the 0.1X dilution HQ>1.0 in any Basin, consider the potential for exposure and response (Section 5.5).

### 5.3.6 Prey Species Effects Analysis

In addition to evaluating the direct effects to ESA-listed salmonids, EPA also considered the potential impact to these species through a reduction in their prey. The Tier I and II approaches were the same for prey as for fish, except that prey categories were analyzed for each ESA-listed salmonid.

#### *5.3.6.a Tier I Prey Toxicity Assessment Approach*

This Tier I analysis is a conservative screening assessment designed to identify those prey categories that may be affected by exposure to EPCs of stormwater pollutants in the Action Area. Consistent with the approach for ESA-listed salmonids, if a HQ for a focal pollutant exceeds 1.0 at the 0.1X dilution, then that pollutant was carried through to Tier II assessment. The Tier I process is described as follows:

1. An updated ECOTOX knowledgebase search was conducted and the results used along with toxicity data from recent (~last five years) ESA consultations.
2. The acute 96-hr toxicity values ($LC_{50s}$) were sorted from low to high by prey category. Three prey categories (fish, crustaceans and invertebrates) were considered for each salmonid species. The acute $LC_{50}$ toxicity values were adjusted using the acute to chronic ratio (ACR) of 8.3 (Raimondo et al. 2007)[11] to chronic NOECs. The toxicity values in mg/L were converted to µg/L by multiplying the value by 1000.
3. The chronic NOEC for each prey category and chemical were sorted, and the prey with the lowest chronic NOEC (derived from $LC_{50}$ values) for each chemical was selected as the Tier I PCLEL (Table 5.11).

[11] The 8.3 ACR is the overall median value derived for 456 aquatic invertebrate and fish ACRs analyzed, with a 16,000-fold range in values (1.1-18,550) and a 32-fold range in 10th and 90th percentile values (2.5-79.5) (Raimondo et al. 2007).

4. The study used to calculate the PCLEL was reviewed for reliability according to the 13-criteria QA process (Section 5.3.2).

If a PCLEL could not be calculated due a lack of toxicity test data, the FCV for the ESA-salmonids or WQC/WQS was used as the PCLEL to determine the effects on prey. In the case of aluminum, we used the lowest GMCV. Once the PCLELs were developed, we repeated the steps from the Tier I salmonid assessment to identify the focal pollutants warranting a Tier II assessment:

1. Calculate the EoP concentration from the *geometric metric mean of the maximum discharge concentrations* for each focal pollutant across the three datasets for each of the 20 Basins to generate all of the EPCs (i.e. EoP, 0.1X, 0.01X, and 0.001X dilution)
2. Calculate the HQ for each focal pollutant using the EoP concentration and PCLEL for each focal pollutant in each basin.
3. If the EoP HQ is less than 1.0, that focal pollutant was eliminated from further consideration.
4. If the EoP HQ is greater than 1.0, then calculate the HQ for that focal pollutant using the 0.1X dilution concentration.
5. If the 0.1X dilution HQ is less than 1.0, that focal pollutant is eliminated from further consideration.
6. If the 0.1X dilution HQ is greater than 1.0 the focal pollutant was evaluated using the Tier II approach.

#### *5.3.6.b Tier II Prey Toxicity Assessment Approach*

The Tier II approach for the assessment of the prey of ESA-listed species evaluates whether EPCs of stormwater pollutants elicit toxicity to a “meaningful portion” of the listed species diet (Suter et.al. 2000). The EPCs are those that have been recalculated using the geomean of the entire dataset. The Tier II screening was done for those stormwater pollutants that did not pass the Tier I conservative screening.

All potential prey species of a listed species (i.e. the community of prey species of an ESA- listed species) were assessed (Table 5.10). This analysis is intended to determine whether EPCs have the potential to impact prey availability for ESA-listed fish. The salmonids evaluated in this BE are secondary or tertiary consumers in aquatic food webs whose abundance may be adversely affected by reductions in the number of prey species available to them. This situation is most likely to occur when prey species are as a group more sensitive to a chemical than are the listed fish species.

Using recent biodiversity research on changes in species richness effects on ecological communities, a decline of more than 20% in species richness of the prey of ESA-listed species is defined in this BE as a meaningful portion of the listed species diet, warranting an adverse effect determination based on an indirect effect on ESA listed species (Hooper et al. 2012, Vaughn, 2010). A 20% change in species richness is consistent with other lines of evidence in water quality criteria derivation and ecological risk assessment, where a 20% change in a parameter is used as a threshold for adverse effects (Suter et. al., 2000).

Reduction in the availability of prey for fish may result in reduced fish growth, fitness and density (number of individuals in a population per unit of area, such as within the Action Area) when and where fish are food limited (Grunblatt et al., 2019). Reduction in prey species richness has been directly linked to changes in fish biomass, production and yield (Brooks et al., 2016, Smokorowski and Kelso, 2002), allowing prey species richness to serve as a surrogate measure for predator species abundance.

Results of the analysis for each focal pollutant are summarized for prey species in the following prey categories: crustaceans, aquatic invertebrates and fish.

Specifically, the literature was compiled, reviewed, sorted, and incorporated into the analysis as follows:

1. An updated literature search was conducted.
2. Chronic toxicity (NOEC) and acute toxicity values ($LC_{50}$/2.27 to adjust to $LC_{Low}$ values) were sorted from low to high by prey category.
3. When one or more PCLELs were less than the EPC, the EPC was deemed potentially adverse and all available species mean acute or chronic values (SMAVs or SMCVs, respectively) were compared to the EPC
    a. In such a case, all studies providing SMAVs or SMCVs were quality assured as described in Section 5.3.2[12].
4. If <20% SMAVs or SMCVs were less than the EPC, the focal pollutant was determined to not result in adverse effects to a listed species through a reduction in prey. If >20% SMAVs or SMCVs were less than the EPC, the focal pollutant was discussed further in the species response section regarding impact to prey and contribution to the likelihood of adverse effects to ESA-listed salmonids.

## 5.4 SPECIES EXPOSURE ANALYSIS

EPA evaluated the exposure of ESA-listed salmonids to focal pollutants through the water column; however, uptake of stormwater pollutants through the food web is also a valid exposure pathway. Evaluating the food web pathway necessitates either using bioaccumulation factors to arrive at tissue concentrations or constructing a food web model. Tissue data are needed to determine adverse effects due to bioaccumulation and toxicity test data from dietary exposures are needed to evaluate the food web pathway. EPA made a concerted effort to obtain site specific tissue data, as well as sediment and invertebrate data, and found that none are available for the Action Area. After

[12] Only studies providing the PCLEL were quality assured because these studies formed the basis for the effect determination. Only studies providing the SMAVs or SMCVs < the criteria value were quality assured because these studies formed the basis for the effect determination.

consideration of the potential duration of exposure due to salmonids lingering and feeding in the vicinity of the discharges, coupled with the degraded nature of the shoreline habitat, EPA determined that constructing a food web model was not warranted. Therefore, EPA evaluated the direct effects from potential exposure via the water column.

The Status of the Species Section provides a detailed description of seasonal use of the Action Area by ESA-listed salmonids, which is key to characterizing their exposure to focal pollutants discharged in stormwater. The factors determining the timing, frequency, duration, and magnitude of the stormwater discharges pertain to climate, precipitation and seasonal anthropogenic water use (e.g. lawn watering, car washing, etc…). Moreover, the duration of exposure depends on fate and transport characteristics of a chemical as well as a species use of the habitat within the Action Area. This use depends on the quality of the habitat and the functions and values it provides for essential behaviors such as feeding and sheltering. If the structural components of the habitat are lacking for fish and their prey, they are not expected to remain for an extended period along the shoreline in the vicinity of the discharges where they could encounter elevated concentrations of focal pollutants.

In order to relativize the location and magnitude of the stormwater discharge with the flow of the receiving waters and exposure of ESA-listed salmonid, EPA has: 1) summarized the data presented in the Lewiston Levee Interior Drainage Reports prepared by the USACE (USACE 2005b; USACE, 2018); 2) described the focal pollutant composition at various discharge locations; and, 3) described the condition of the habitat in the vicinity of the discharges.

### 5.4.1 Army Corp Interior Drainage Evaluation Reports

The USACE (USACE 2005; 2018) prepared Interior Drainage Evaluation reports (hereafter USACE Reports) to characterize the timing, frequency and magnitude of the discharges from the levee ponds to the Clearwater River for water years 1991 to 2018. Approximately 7.9 square miles within the Action Area drains to four separate collection ponds and pumping plants. Two interior drainage areas, Area 380 and Lindsay Creek (Area 370) drain directly to the Clearwater River (Figure 5.2).

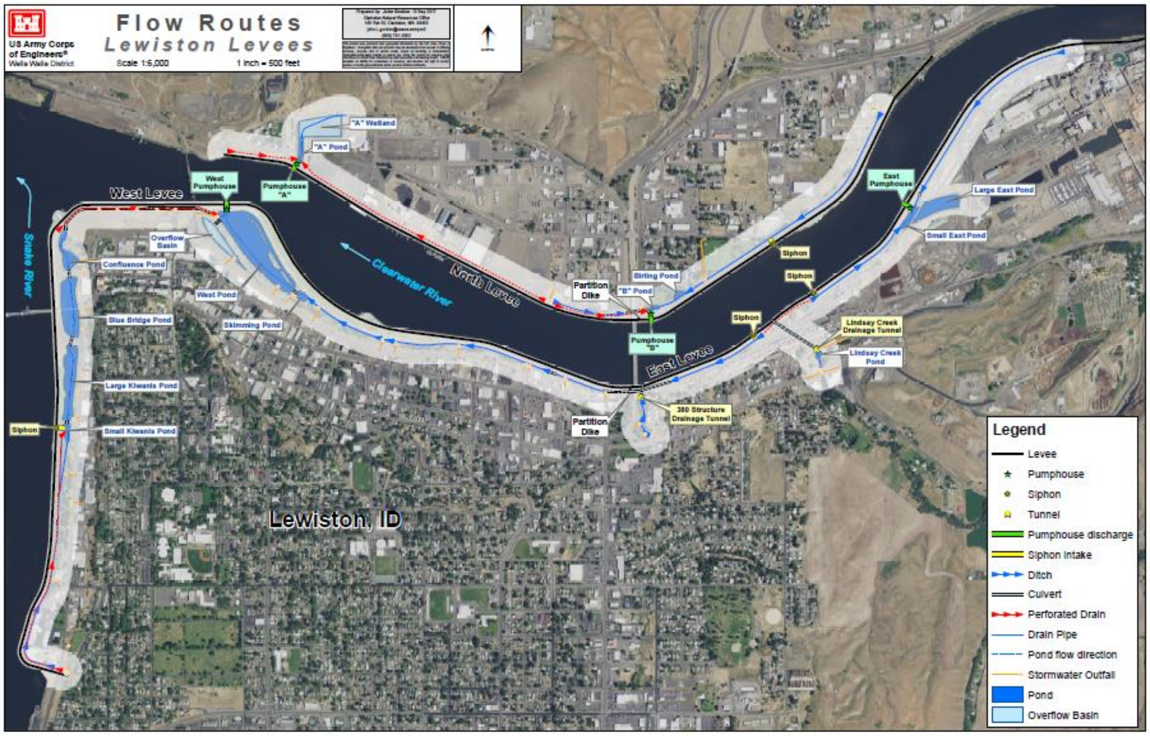


***Figure 5.2. Drainage Map and Flow Routes for Ponds and Basins in the Action Area***

The USACE calculated the seasonal pumping rates for the levee ponds using pump data, less flows from the water quality siphons. They determined that this was the best available data to be used as the estimator of natural seepage and runoff due to the great uncertainty in computing natural runoff in these small local drainage areas (Table 5.12). The USACE defined the seasons as follows: Winter (January through March), Spring (April through June), Summer (July-September) and Fall, (October through December).

***Table 5.12. Seasonal Pumping Rates (mean cfs) including natural runoff, seepage and siphon water between 4/1991 to 11/ 2004 (From ACOE 2005a)***

| **Season** | **West Levee** | **East Levee** | **North B Levee** | **North A Levee** |
|---|---|---|---|---|
| Winter | 6.01 | 0.14 | 0.55 | 0.85 |
| Spring | 14.13 | 1.23 | 2.11 | 0.73 |
| Summer | 24.09 | 1.39 | 2.95 | 0.72 |
| Fall | 12.26 | 0.44 | 1.24 | 0.82 |

*Note: The East Levee is outside of the Action Area*

The West Levee pond has the highest pumping rate of all ponds with approximately an order of magnitude greater during all seasons (Table 5.12). The West Levee Pond is the furthest downstream point of discharge in the Action Area. In general, pumping rate is highest in summer, approximately twice that of fall and winter (Figure 5.3). Notably, the pumping rate is lowest in winter from all ponds.

The USACE (USACE, 2005) obtained the seasonal flow data for the Clearwater River from the USGS gaging station at Spalding (13342500) and compared it to the pumping rate for the levee ponds. A conservative scenario comparing the 100-year pond discharges to the Clearwater River 10- year flood; a high unlikely interior proportion to the Clearwater River flows, indicate that the ponds contribute less than 0.3 of the 10-year Clearwater flows for the 100-year interior flood (Figure 5.3).

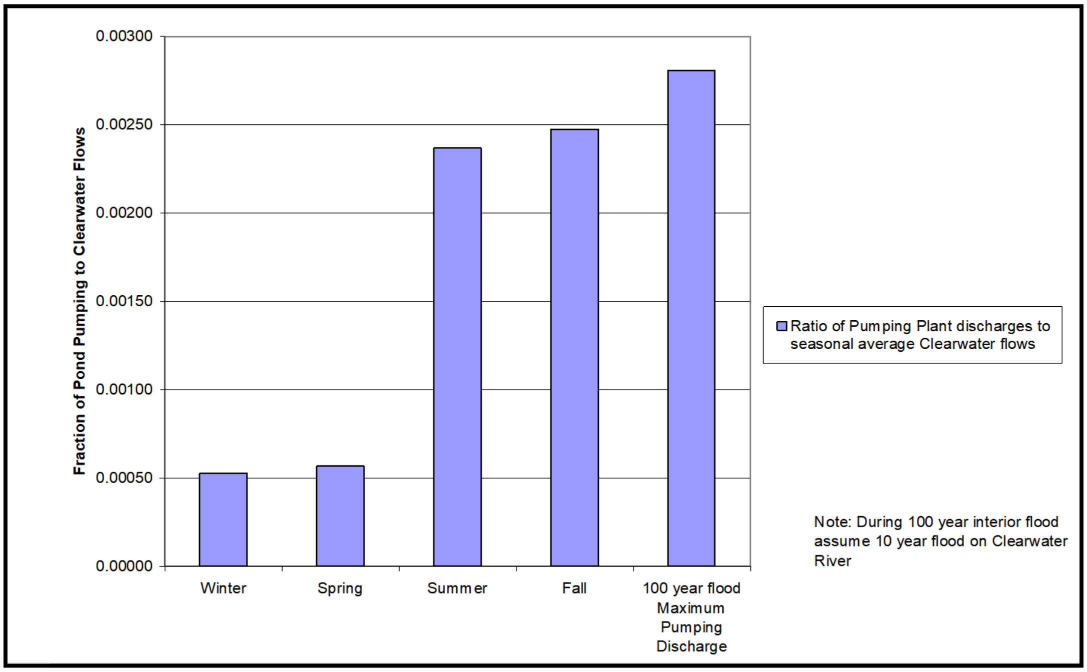


***Figure 5.3. Comparison of total pond discharges to the Clearwater River (from USACE, 2005).***

***The 2018 USACE report made a limited comparison of the Lewiston Levee interior drainage area pumping rates and the Clearwater River flows (***

Table 5.13). The USACE reported that the "*results indicate that this ratio was less than 0.01 for 99% of the annual record between water years 1991 and 2018, with a maximum ratio of 0.0146, a mean ratio of 0.0016 (±0.002). Seasonal trends indicate that ratios exceeding the median of 0.0009 are generally exceeded less than 50% of the time, with the highest ratios occurring during Q3 (Jul – Sep) and Q4 (Oct – Dec). Note that these ratios could be considered conservative since they were not corrected for the additional inflow provided by the water quality siphons (which the prior analysis showed could substantially reduce the relative pumping rates).*"

***Table 5.13. Seasonal ratio of mean pumping rates for Lewiston Levee interior drainage areas to Clearwater River mean daily flow rates for available period of record spanning water years 1991-2018 (From ACOE 2018).***

| % Time Exceeded | Q1 (Jan-Mar) | Q2 (Apr-Jun) | Q3 (Jul-Sep) | Q4 (Oct-Dec) | ANNUAL |
|---|---|---|---|---|---|
| 99% | 0.00008 | 0.00005 | 0.00049 | 0.00022 | 0.00007 |
| 95% | 0.00013 | 0.00008 | 0.00075 | 0.00044 | 0.00013 |
| 90% | 0.00018 | 0.00010 | 0.00087 | 0.00059 | 0.00020 |
| 80% | 0.00029 | 0.00015 | 0.00114 | 0.00080 | 0.00036 |
| 50% | 0.00054 | 0.00040 | 0.00178 | 0.00129 | 0.00091 |
| 25% | 0.00087 | 0.00070 | 0.00354 | 0.00208 | 0.00164 |
| 15% | 0.00119 | 0.00096 | 0.00633 | 0.00463 | 0.00233 |
| 10% | 0.00137 | 0.00115 | 0.00755 | 0.00695 | 0.00399 |
| 5% | 0.00163 | 0.00156 | 0.00884 | 0.00906 | 0.00733 |
| 2% | 0.00200 | 0.00221 | 0.00960 | 0.01030 | 0.00922 |
| 1% | 0.00219 | 0.00266 | 0.00992 | 0.01124 | 0.00994 |
| n: WY 1991 - 2018 | 2,613 | 2,636 | 2,627 | 2,576 | 10,452 |

Both USACE Reports (2005 and 2018) indicate that the levee pond discharges are relatively minor based on the ratios of the pumping rates to the flow of the Clearwater River for water years 1991 to 2004 and 1991 to 2018; these reports present data which show that the flows are less than 0.03 for a 100-year flood/10-year pond discharge, and 0.01 over all quarters and years, respectively.

### 5.4.2 Summary of Habitat Quality

The entire shoreline of the Action Area along the Snake and Clearwater Rivers is hardscaped with riprap (Figure 5.4 and Figure 5.5). There is a 13.5-mile paved trail, the Lewiston Levee Trail, that runs the length of the shore. This levee is practically devoid of vegetation or trees. This lack of vegetation along with the hardscape shoreline and channel modification reduces the function and value of salmon habitat, resulting in a reduction in prey in the Action Area and an increase in warm water predatory fish. According to NMFS (2019) both hydropower and land use have impacted habitat in the mainstem Snake River above LGDP. Historical habitat loss is a primary limiting factor in degradation of critical habitat for Fall/Spring/Summer run Chinook resulting in impacts to juvenile and adult salmon. This habitat degradation contributes to elevated water temperature, presence of invasive plants and warmwater piscivores which prey on and contribute to the low survival of juvenile Snake River Fall Chinook salmon (Erhardt et al., 2018; NMFS, 2019).


***Figure 5.4. Google Earth Image of a portion of the Action Area with the Levee ponds and riprapped hardscape along shoreline.***


***Figure 5.5. Google Earth Image close up of a portion of a Levee Pond, with focus the riprapped hardscape along shoreline.***

The West Lewiston Levee is approximately 17,000 ft long and combines a central impervious core supported on both sides by fill and overlain with rock hardscaping (Figure 5.6 USACE, 2004).

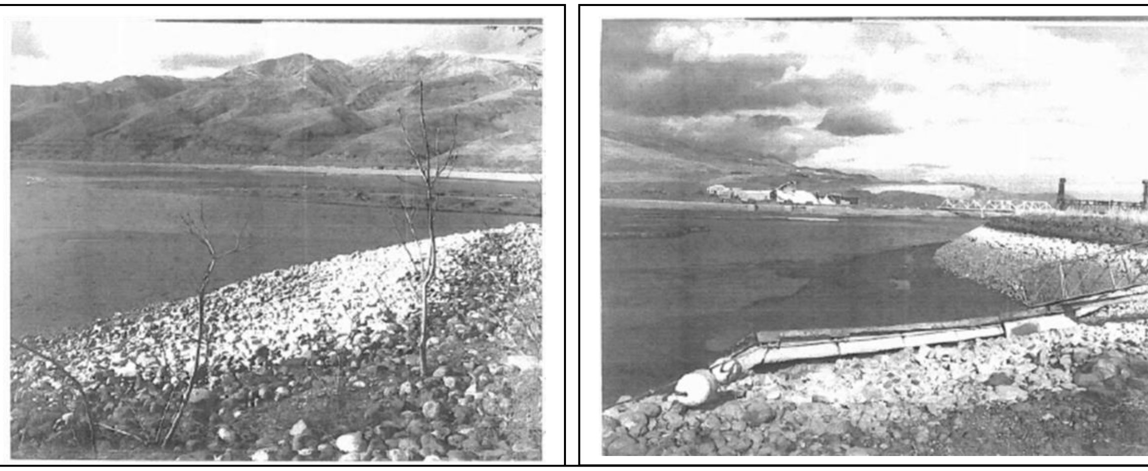

***Figure 5.6. Photos of shoreline during the 1992 drawdown***

The modification of the shoreline habit discourages the development of aquatic and riparian vegetative communities which salmon need to find prey and cover. Suitable habitat is limited in the LGDP with only 29 percent considered suitable. These areas occurred more in the upper end of the reservoir as the presence of suitable shoreline habitat is related to areas with low sloping topography (more dominant topography in the upper portion). Most riprap is on the north side of the reservoir and the Clearwater River arm. The normal riverine structural components are missing and so salmonid (specifically outmigrants) use depth and pelagic orientation to avoid predators. Predators in the Action Area include smallmouth bass and pikeminnow which prey on out-migrating juvenile Chinook (Section 4.2).

### 5.4.3 Salmonid Species Travel Time Analysis

EPA used swimming speed, as reported in Section 3.2, to predict the duration of exposure of most ESA-listed salmonids[13] to the stormwater discharge plumes (assuming continuous presence of pollutants even though discharges are episodic). The swimming speed of the adult and sub-adult (including out-migrating lifeforms) is available through the University of Washington DART Database and from various publications (see Section 3.2.2; Table 3.10 and Table 3.14). EPA utilized this information to predict the length of time the species/ESU/life stage would take to travel through the Action Area and through the 0.1X dilution zone of the plumes at the various discharge locations. The swimming speed varies according to the magnitude of the flow and where possible we used the highest flow for the slowest swimming speed to conservatively predict exposure. EPA assumes that this documented empirical swimming speed data and travel time considers essential behaviors including resting, holding and feeding (out-migrants only) as these are empirical data collected for location that includes the Action Area.

The Action Area encompasses a larger area than the discharge locations, however, fish can only be exposed to the discharge plume in the vicinity of the discharge points.

[13] There was no swimming speed or travel time data available for bull trout

Therefore, we identified the most upstream discharge location in both the Snake River and the Clearwater River and used the downstream location predicted using the CORMIX model. These distances in the Snake and Clearwater Rivers are 7.0 Km and 4.5 Km, respectively and the distance from Lower Granite Dam to the confluence of the Snake and Clearwater Rivers is 50 km. EPA used these linear distances and the slowest swimming speed to calculate the maximum exposure durations for each species and life stage. The results are presented in Table 5.14, below, and are discussed in the timing and duration of exposure sections for each species.

***Table 5.14. Estimated exposure duration in the nearfield plume (0.1X dilution) based on swimming speed and travel time from the lower Granite Dam to the confluence of the Snake and Clearwater Rivers***

<table>
<tr><th rowspan="2">Species/ESU</th><th rowspan="2">Lifestage</th><th colspan="3">Travel Time from Source (km/day)</th><th colspan="2">Through the Action Area (day)</th><th rowspan="2">Through the 0.1X dilution (hr.)</th></tr>
<tr><th>Distance (Km)</th><th>Speed Km/day</th><th>Total Travel time (days)</th><th>Snake R.</th><th>Clearwater R.</th></tr>
<tr><td rowspan="2">SR Fall Chinook</td><td>Adult</td><td>50</td><td>24 to 27</td><td>2.1</td><td>0.29</td><td>1.9</td><td>0.025</td></tr>
<tr><td>Sub-yearling</td><td>92 to 173</td><td>2 to 4</td><td>43.5 (mean)</td><td>3.5</td><td>2.25</td><td>0.3</td></tr>
<tr><td rowspan="2">SR Spring/Summer Chinook</td><td>Adult</td><td>50</td><td>12 to 50</td><td>4.17</td><td>0.58</td><td>1.08</td><td>0.05</td></tr>
<tr><td>Yearlings</td><td>50</td><td>4.7 to 1.2</td><td>10.6 to 41.3</td><td>1.48</td><td>0.95</td><td>0.13</td></tr>
<tr><td rowspan="2">SR Sockeye</td><td>Adult</td><td>50</td><td>21 to 26</td><td>2.38</td><td>0.33</td><td>0.21</td><td>0.3</td></tr>
<tr><td>Smolt</td><td></td><td>2 to 4</td><td></td><td>3.5</td><td>2.25</td><td>0.3</td></tr>
<tr><td rowspan="2">SR Steelhead</td><td>Adult</td><td>50</td><td>13 to 33</td><td>3.85</td><td>0.54</td><td>0.35</td><td>0.05</td></tr>
<tr><td>Smolt</td><td>50</td><td>4.6 to 20.1</td><td>10.7</td><td>1.5</td><td>0.97</td><td>0.13</td></tr>
<tr><td colspan="8">Distance of Action Area in the Snake River: 7 km<br>Distance of Action Area in the Clearwater River: 4.5 km<br>Distance of the nearfield 0.1X dilution: 25m (0.025 Km)</td></tr>
</table>

### 5.4.4 CORMIX Model and Dilution Areas

As described in Appendix 1, EPA used the CORMIX model (version 11.0) to delineate the downstream area that would exhibit pollutant concentrations above background levels and to predict the spatial extent of the 0.1X dilution zone to assist with the exposure analysis.

EPA modeled the stormwater runoff discharges from the MS4 as if they were one continuous discharge originating from a single outfall located in the middle of the confluence of the Snake and Clearwater Rivers. Accurately modeling all MS4 discharges separately proved to be too difficult, therefore EPA determined modeling them as a single discharge would be effective in determining the extent of the Action Area. Appendix 1 provides a more detailed discussion of the methodology.

The CORMIX modeling results estimate the size of the 0.1X dilution area and the nearfield dilution area to be 21m and 26m, respectively, centered on the discharge point. For the purposes of calculating travel time through the 0.1X dilution zone we assumed a distance of 25m for each of the discharge locations in the Clearwater and Snake Rivers (Figure 5.7).

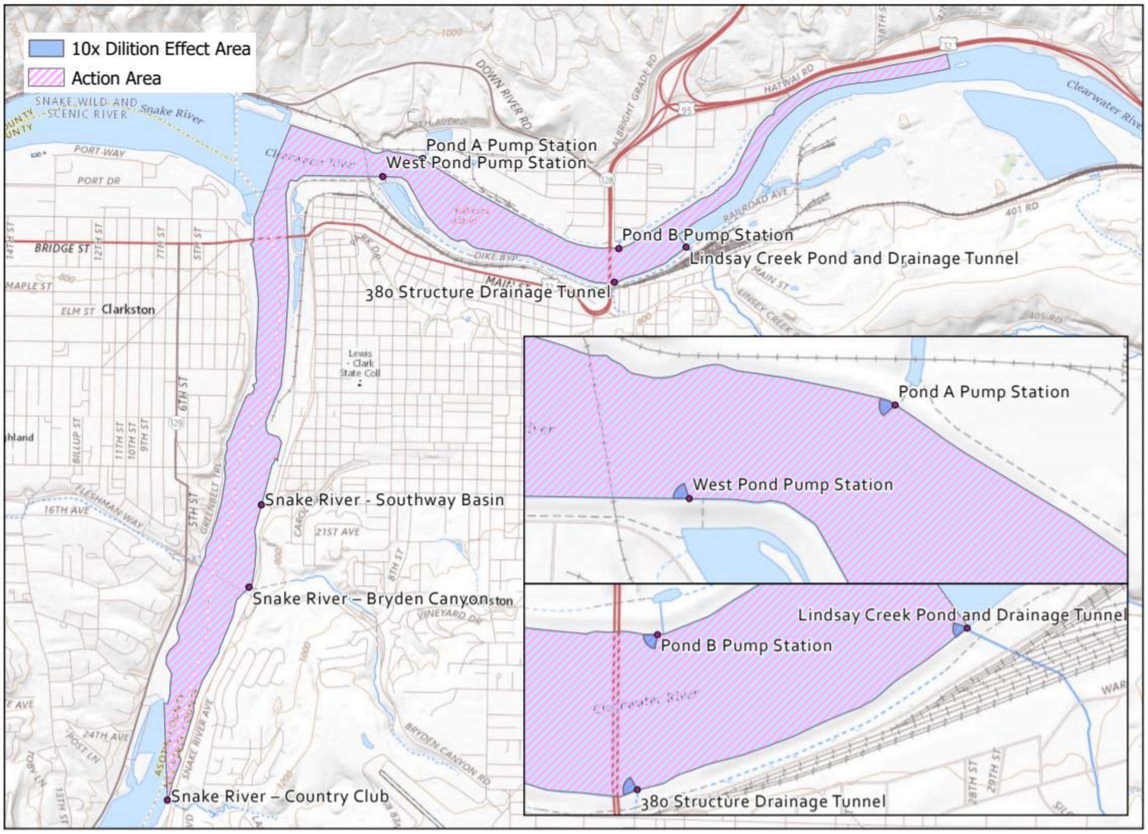


***Figure 5.7. Map of Action Area with 0.1X dilution zones (blue plume icon) shown on select outfalls for scale.***

### 5.4.5 Snake River Chinook (Fall ESU)

Understanding the timing of migration, behavior and activities expressed by these different lifestages is integral to determining the potential for exposure of Chinook to EPCs of stormwater pollutants. Fall Chinook salmon are estimated to be in the Action Area while migrating upstream to spawn as adults and out-migrating sub-yearlings (Section 3.2.2.f).

### *5.4.5.a Coincidence of Species and Discharges*

According to NMFS (2019) adult salmon migrate upstream through main channels in relatively deep water, typically along slower velocity peripheries that may include aquatic and riparian vegetation. Adults may use aquatic vegetation for cover or current breaks and for thermal and water quality benefits when migrating or holding in refugia. The habitat in the Action Area does not provide significant aquatic vegetation for cover (Figure 5.4 thru Figure 5.6). The shoreline of both banks of the Clearwater River and the east bank of the Snake River are hardscaped with rip rap to accommodate the levee systems and the Lewiston Trail. This levee is devoid of vegetation, which would otherwise provide a terrestrial invertebrate prey base, overhanging cover from aerial predators, and shade for resting and thermoregulation.

According to multiple authors in NMFS (2019) *"migrating smolts (including many sub-yearlings) in the lower Snake River mostly use deeper, faster-flowing, mid-channel or peripheries…"*. Since migrating Chinook are moving through the Action Area in June, July and August it is likely that they are using the midchannel, while feeding on the surface. Their exposure for the short duration calculated depends on the location of the plume relative to the fishes preferred habitat and whether a plume is actively being discharged during their time in the Action Area.

### *5.4.5.b Timing and Duration of Exposure*

The duration of exposure depends on the use of the habitat while in the Action Area to support essential behaviors (feeding, sheltering). This duration has been measured by various authors who document the movement of PIT--tagged hatchery fish and movement of sub yearling fish out migrating from natal areas to the ocean (Smith et al. 2003; Connor et al. 2003).

Section 3.2.2.f. presents the passage at lower Granite Dam by adult and sub-yearling Fall Chinook, respectively, for the period between 2006 and 2016. Upstream passage of adult fall Chinook into the LGDP occurred from late August (earliest August 17) to early November (latest date December 15). The timeframe for the majority of wild fall Chinook out-migration is relatively narrow (during June, July, and August over the monitored years); the fraction of the total population out-migrating during a given week is relatively constant from one year to another. According to Figure 3.5, most out-migrating sub-yearling wild fall Chinook passed over the Lower Granite Dam in June and July in sampled years 2006 to 2015.

As described in Section 3.2.2, Skalski et al. (1996) measured juvenile fall Chinook migration speed during both moderate and low river flows in the Columbia River, downstream of its confluence with the Snake River. Swimming speed was dependent on flow rates and where flow rates were approximately 8500 m3/s, migration speeds were 40 km/day to 55 km/day. At lower flows, approximately 4250 m3/s, migration speeds were 24 km/day to 27 km/day. Adult fall Chinook can swim 25 to 50 km/day (Section 3.2.2.b). The distance from the confluence of the Snake and Clearwater rivers and the Lower

Granite Dam is approximately 50 km (31 miles). Migrating adult fall Chinook require one to two days travel time between the Lower Granite Dam and the confluence of the Snake and Clearwater Rivers, and may spend hours or days in the cold-water refuges of the confluence. EPA assumes that this holding time is accounted for in the travel time described.

Travel times from the free-flowing section of the Snake River through the Lower Granite Dam were calculated for sub-yearling fall Chinook using PIT-tagged hatchery fish (Smith et al. 2003). The average travel time from the flowing portion of the river to the dam was 43.5 days (approximately 2 – 4 km/day). The distances traveled were 173 km and 92 km (Section 0). According to Connor et al. (2003), wild fall Chinook juveniles spend a significant portion of this time period rearing (feeding and growing) or dispersing passively downstream rather than actively migrating downstream. EPA assumes that this rearing time is accounted for in the travel time described.

According to the exposure estimations adults are expected to swim through the Snake River and Clearwater River portions of the Action Area in 0.29 and 0.19 days respectively (Table 5.12). They are expected to swim through the 0.1X dilution portion (25 m) of the plumes in 0.025 hrs. These estimates are for Chinook traveling through the Action Area without feeding on their migration to spawn.

We also calculated exposure time for sub-yearling Chinook during outmigration. These calculations were based on the slowest swimming speed and farthest distance data from Connor et al. (2003); although data for the sub-yearling fish was available for the Action Area (Table 3.10). We used a 4 km/day rather than 2 km/day swimming speed reported both in Connor et al (2003) and for individuals released in the Action Area to provide a more conservative interpretation of exposure. The results presented in Table 5.12 show that sub-yearling Chinook are expected to travel through the Snake River and Clearwater River over a 3.5 day and 2.25 days period. Traveling through the nearfield 0.1X dilution zones portion of the plume is expected to take 0.3 hrs.

Because this is empirical data that includes the Action Area, we expect that rearing behaviors are addressed.

#### *5.4.5.c Summary of Exposure*

EPA does not expect that adult Chinook would be exposed to stormwater discharges directly through the surface water nor dietary pathways because: 1) travel time through the Action Area is rapid, particularly in the 0.1X dilution zones (25 m) of the stormwater plumes, 2) they migrate through a relatively deep main channel, particularly in late summer and fall when discharges are lower when water temperature would be elevated, 3) there is little shoreline vegetation to provide for resting and current breaks, and 4) they do not eat while migrating. Therefore, exposure to the stormwater and stormwater constituents is expected to be minimal and is not expected to result in adverse consequences for adult Fall Chinook and they are not discussed further in this BE.

However, out-migrating sub-yearling fish are likely to be exposed to discharges for the limited time they migrate through the Action Area (2 to 3 days) and through the 0.1X dilution zone of the stormwater plumes (approximately 20 minutes). This limited exposure to the plume depends on its juxtaposition with the outmigrants. Habitat in the Action Area is significantly degraded by channel modification, hardscaping and the presence of predatory warmwater fish; these factors are likely to influence the use of the shoreline by outmigrants. Water temperature will also influence use of the shallow shoreline areas, as described previously. Considering these factors, we are assuming that sub-yearling outmigrants may be exposed to focal pollutants for a short duration. This duration will be considered in the species response analysis.

### 5.4.6 Snake River Chinook (Spring/Summer ESUs)

The Action Area is within the spring/summer Chinook salmon migration corridor used by adult and sub-yearling life history forms.

#### *5.4.6.a Coincidence of Species and Discharges*

According to NMFS (2019) adult salmon migrate upstream through main channels in relatively deep water, typically along slower velocity peripheries that may include aquatic and riparian vegetation. Adults may use aquatic vegetation for cover or current breaks and for thermal and water quality benefits when migrating or holding in refugia. The habitat in the Action Area does not provide significant aquatic vegetation for cover (Figure 5.4 thru Figure 5.6). The shoreline of both banks of the Clearwater River and the east bank of the Snake River are hardscaped with rip rap to accommodate the levee systems and the Lewiston Trail. This levee is devoid of vegetation which would otherwise provide a terrestrial invertebrate prey base, overhanging cover from aerial predators, and shade for resting and thermoregulation.

Yearling Chinook migrate downstream through the area primarily from April through June. During this period rainfall is at its peak with 1.2” to 1.6”/month and 8 to 10 days of rain per month. Additionally, mean pumping rate from the West Levee pond in spring is 14 cfs, second only to the winter rate of 24 cfs (Section 5.4.1). Runoff from these storms is stored in the levee ponds and periodically discharged into the Clearwater River.

Both USACE reports (2005 and 2018) indicate that the levee pond discharges are relatively minor based on the ratios of the pumping rates to the flow of the Clearwater River for water years 1991 to 2004 and 1991 to 2018; these reports present data which show that the flows are less than 0.03 for a 100-year flood/10-year pond discharge, and 0.01 over all quarters and years, respectively. This minor (less than 1 percent) contribution of stormwater to the Clearwater River is considered an important factor in the potential for exposure of Chinook.

#### *5.4.6.b Timing and Duration of Exposure*

As shown by the bimodal distribution in Figure 3.7, adults arrive at lower Granite Dam from April through August. They reach their natal tributaries between June and August and spawning occurs in August and September one to four months after they begin their migration (Myers et al, 1998).

Yearling wild spring/summer Chinook passed over the Lower Granite Dam primarily between mid-April and end of May from 2006 to 2016 (Figure 3.8). On average, half the fish passed the Lower Granite Dam between May and June and 95 % had moved downstream through the dam by early June. The last 5% of fish migrated as late as December. The periods of migration through the Lower Snake River for hatchery-reared Chinook were comparable to those for wild spring/summer Chinook.

Migration travel timing data is available for spring/summer chinook traveling between most of the major dams and reservoirs in the lower Columbia and Snake River (Section 3.2.3.f). These data capture migration over a five-year period. Median values reported for the five-year duration ranged from 12 km/day to 38 km/day, with a mean of 25.7 km/day.

Keefer et al. (2003) also studied adult spring/summer Chinook migration speed in Columbia and Snake River reservoirs (Bonneville, Dalles, John Day, McNary to Ice harbor, McNary to Hanford receiver, Ice Harbor, Lower Monumental, Little Goose, Lower Granite to Snake River receiver, and Lower Granite to Columbia River receiver) over the same five-year period. Median values reported for the five-year duration ranged from 16 km/day to 83 km/day, with a mean of 61.3 km/day. Bjornn et al. (2000) also studied adult spring/summer Chinook migration speed through pools, speeds ranged from 43.2 km/day to 61.5 km/day, with a mean of 51.4 km/day.

As described in Section 3.2.4, a range of mean migration distance for adult spring/summer Chinook is approximately 12 to 50 km/day. The distance from the Lower Granite Dam to the confluence of the Snake and Clearwater Rivers is approximately 50 Km. Given the mean migration speeds observed in the literature, adult spring/summer Chinook may require one to four days to travel between the Lower Granite Dam and the Clearwater and Snake River confluence.

Using the available data, we estimated the travel time through the Action Area and the 0.1X dilution zone of the discharge plumes (Table 5.14). According to the exposure estimations adults are expected to swim through the Snake and Clearwater River portions of the Action Area in 0.58 and 0.18 days respectively. They are expected to swim through the 0.1X dilution zones (25 m) in 0.05 hrs (3.0 min). These estimates are for Chinook traveling through the Action Area without feeding on their migration to spawn. Because these are empirical data, EPA assumes that resting and holding time are included in the swimming speeds between locations.

EPA also calculated exposure time for sub-yearling Chinook during outmigration. These calculations were based on travel times of wild Chinook juveniles estimated from the PTAGIS database by NMFS (2003). Juveniles trapped and tagged at a Snake River and a Clearwater River trap from 1990-2003 were detected at the Lower Granite Dam allowing for estimates of travel time. EPA used the mean of the Snake River and Clearwater River mean and 99.5 percentile travel times (Table 3.14) as the range for swimming speed from the Lower Granite Dam to the confluence of the Snake and Clearwater Rivers. The final estimates for travel time through the Action Area and the 0.1X dilution zone of the stormwater plumes were completed using the lowest (4.74 km/day) swimming speed in order to provide a conservative estimate and because there were caveats associated with these data which compelled a more conservative estimate of exposure.

The results presented in Table 5.14 show that sub-yearling Chinook are expected to travel through the Snake River and Clearwater River over a 1.5 day and 0.95-day period. Traveling through the nearfield 0.1X dilution zone of the plume is expected to take 0.13 hrs or 8 minutes.

#### *5.4.6.c Summary of Exposure*

EPA does not expect that adult Spring/Summer Chinook would be exposed to stormwater discharges directly through the surface water nor dietary pathways because: 1) travel time through the Action Area is rapid particularly in the 0.1X dilution zones (25 m) of the stormwater plumes, 2) they migrate through relatively deep main channel, particularly in late summer and fall when discharges are lower when water temperature would be elevated, 3) there is little shoreline vegetation to provide for resting and current breaks, and 4) and they do not eat while migrating. Therefore, exposure to focal pollutants is expected to be minimal and adult chinook are not discussed further in this BE.

However, out-migrating sub-yearling fish are likely to be exposed to discharges for the limited time they migrate through the Action Area (1 to 1.5 days) and through the 0.1X dilution zone of the stormwater plumes (approximately 10 mins). This limited exposure to the plume depends on its juxtaposition with the outmigrants. Habitat in the Action Area is significantly degraded by channel modification, hardscaping and through the presence of predatory warmwater fish. The factors are likely to influence the use of the shoreline by outmigrants. Water temperature also influence use of the shallow shoreline areas as described previously. Considering these factors, EPA is assuming that sub-yearling outmigrants may be exposed to focal pollutants for a short duration. This duration will be considered in the species response analysis.

### 5.4.7 Snake River Sockeye

As with Chinook, the Action Area is within the migration corridor used by Snake River sockeye salmon adult and smolt life history forms. Juveniles migrate from Redfish Lake primarily in late April and May, concurrent with the start of peak river flows and warmer water temperatures (38 to 50 °F) (Bjornn et al., 1968 as cited in NMFS, 1991).

#### *5.4.7.a Coincidence of Species and Discharges*

Precipitation events and pond discharges are lowest in winter and spring but then pickup in summer to levels that approximate fall. Therefore, both lifestages of sockeye may be exposed to discharges while migrating. Both USACE Reports (2005 and 2018) describe the levee pond discharges as relatively minor based on the ratios of the pumping rates to the flow of the Clearwater River for water years 1991 to 2004 and 1991 to 2018; these reports present data which show that the flows are less than 0.03 for a 100-year flood/10-year pond discharge, and 0.01 over all quarters and years, respectively.

The location in the water column influences the potential for exposure of all salmonid's species and lifeforms. According to NMFS (2019), adult salmon migrate upstream through main channels in relatively deep water, typically along slower velocity peripheries that may include aquatic and riparian vegetation. Adults may use aquatic vegetation for cover or current breaks and for thermal and water quality benefits when migrating or holding in refugia. And while orientation within the water column is not specifically known for adult sockeye, hydroacoustic surveys (USACE, 1991) found larger fish are typically oriented near the bottom in the Lower Granite Reservoir. Hydroacoustic surveys conducted in May and June found out-migrating juveniles were located throughout the water column with the greatest concentration in the upper 15 meters. Juvenile migration corridors must have adequate substrate, water quality and quantity, temperature, velocity, cover, food, riparian vegetation, space, and safe passage conditions. The habitat in the Action Area does not provide significant aquatic vegetation for cover and may also limit other necessary migratory habitat features and adequate prey (Figure 5.4 thru Figure 5.6).

As water temperatures increase in nearshore areas migrating smolts may move away from shallow shoreline areas and disperse offshore. Depending on the flow and the thermal stratification of the River the offshore repositioning of juveniles may reduce their exposure to stormwater discharges. According to multiple authors in NMFS (2019) *"migrating smolts (including many sub-yearlings) in the lower Snake River mostly use deeper, faster-flowing, mid-channel or peripheries…".*

The Action Area encompasses the confluence of the Snake and Clearwater Rivers where the water velocity is greater and temperature colder as the waters of the Clearwater flow into the warmer waters of the Snake River. As for other salmonid species, this area may be thermal refuge to migrating smolts and adults (NMFS, 2003). Some of these migrating fish may remain in this refuge for a few hours or days before continuing their migration. However, EPA is assuming that time spent holding in this location is accounted for in the documented travel time.

### *5.4.7.b Timing and Duration of Exposure*

Smolts migrate downstream through the area from March through mid-November. In recent years, most outmigrants have passed Lower Granite Dam from mid-May through mid-July (USACE, 2002). Most of the wild juvenile sockeye pass Lower Granite Dam from March through early September, with outmigration lasting into November (USACE, 2002). Returning adult sockeye salmon migrate upstream past Lower Granite Dam in the Summer/fall with most passing upstream prior to September.

Based on travel time estimates between Columbia River dams developed by Quinn et al. (1997; Section 3.2.4.f), it is estimated that sockeye would take less than two days to travel from lower Granite Dam to the confluence of the Snake and Clearwater rivers (based on the slowest calculated travel rate of 27.2 km/day. Therefore, the fish data collected at the dam can be used to estimate run timing as well as fish abundance in the Action Area.

A range of mean migrations speeds for adult sockeye of approximately 21 to 26 km/day has been observed. This distance from the confluence of the Snake and Clearwater Rivers and the Lower Granite Dam is approximately 31 miles, or 50 km. Given the mean migration speeds observed in the literature, sockeye may require two to two and a half days to travel between the confluence of the Snake and Clearwater Rivers and the Lower Granite Dam. Data on travel times for juvenile sockeye were not found.

Using the available data, we estimated the travel time through the Action Area and the 0.1X dilution zones of the discharge plumes (Table 5.14). According to the exposure estimations adults are expected to swim through the Snake and Clearwater River portions of the Action Area in 0.33 and 0.21 days respectively. They are expected to swim through the 0.1X dilution portion (25 m) of the plumes in 0.03 hrs (2.0 min). These estimates are for Sockeye traveling through the Action Area without feeding on their migration to spawn. Because these are empirical data, we assume that resting and holding time are included in the swimming speeds between locations.

There was no swimming speed data for Sockeye salmon smolts, therefore we assumed that they would swim at a similar rate as juvenile Chinook, discussed previously. We used the slowest travel time values from Chinook data to predict exposure of sockeye, which was for Fall Chinook sub-yearlings. These calculations were based on using the slowest swimming speed and farthest distance data from Connor et al. (2003); although data for the sub-yearling fish was available for the Action Area (Table 3.10). We used a 4 km/day rather than 2 km/day swimming speed reported both in Connor et al (2003) and for individuals released in the Action Area to provide a more conservative interpretation of exposure. Assuming the results are representative of Sockeye smolts, these fish are expected to travel through the Snake River and Clearwater River over a three and a half and two and a quarter day periods. Traveling through the nearfield 0.1X dilution zone of the plume is expected to take 0.3 hrs or 18 minutes.

### *5.4.7.c Summary of Exposure*

EPA does not expect that adult sockeye would be exposed to stormwater discharges directly through the surface water nor dietary pathways because: 1) travel time through the Action Area is rapid particularly in the 0.1X dilution zones of the stormwater plumes, 2) larger fish are typically oriented near the bottom in the LGDP they migrate through relatively deep main channel, 3) there is little shoreline vegetation to provide for resting and current breaks, and 4) they do not eat while migrating. Therefore, exposure to focal pollutants is expected to be minimal therefore adult sockeye not discussed further in this BE.

However, if swimming speed and travel time data for juvenile Chinook is representative of sockeye smolts they are likely to be exposed to discharges for the limited time they migrate through the Action Area (1 to 1.5 days) and through the 0.1X dilution zones of the stormwater plumes (approximately 10 mins). This limited exposure to the plume depends on its intersection with the outmigrants. Habitat in the Action Area is significantly degraded by channel modification, hardscaping and the presence of predatory warmwater fish. The factors are likely to influence the use of the shoreline by outmigrants. Water temperature also influences use of the shallow shoreline areas as described previously. Hydroacoustic surveys found out-migrating juveniles were located throughout the water column with the greatest concentration in the upper 15 meters. Considering these factors, we are assuming that sockeye smolts may be exposed to focal pollutants for a short duration based on travel time, notwithstanding their position in the water column which may reduce exposure further. This duration will be considered in the species response analysis.

### 5.4.8 Snake River Steelhead

The Action Area is within the migration corridor used by adult and juvenile lifeforms of Snake River steelhead. Steelhead are estimated to be in the Action Area in various life stages throughout the year.

#### *5.4.8.a Coincidence with the Discharges*

Adult steelhead typically occur in the vicinity of the Snake/Clearwater confluence for about 4-5 months annually. Bjornn et al. (2003) used telemetry studies from 1991-1995 to study the migration of adult steelhead past dams and through reservoirs in the lower Snake River and into the tributaries. They observed that many adult steelhead entered the Clearwater River in the fall, but large numbers of steelhead destined for the Clearwater River over-wintered in the LGDP, near the confluence of the Snake and Clearwater Rivers and in the Snake River between Lewiston, ID, and Asotin. Therefore, those adult fish overwintering near the confluence and within the Snake River portion of the Action Area may be exposed to stormwater discharges primarily from the West Levee Pond and in the Snake River. They are not anticipated to be exposed to discharges upstream of the North Levee A and B in the Clearwater River (Figure 2.2).

Neither the cities of Asotin or Clarkston appear to have levee or hardscaped shoreline. In fact, the eastern shoreline of the Snake River appears (via Google Earth) to have substantial vegetation which provides cover, shade and a terrestrial prey base of overwintering steelhead. Conversely, the Lewiston side of the Snake River is hardscaped with a levee through this portion of the Action Area. It is likely that steelhead will use the east shore of the Snake River where habitat is more likely to provide the functions and values needed. The eastern shore of the snake river is 0.2 to 0.44 Km from the discharge points on the western shore of the Snake River from Lewiston. Assuming that steelhead are using the deep channel of the Snake River in winter the discharges would be 100 to 220m and likely buoyant due to the temperature difference between the discharge and the River. At this distance stormwater pollutants would be immeasurable by the time steelhead utilizing habitat on the eastern shore would encounter the plume. According to the output of the CORMIX model the 0.1X dilution zone (using a worst-case scenario) is predicted to be 25m. Therefore, if overwintering steelhead were using the midchannel of the Snake River would be well out of the 0.1X dilution zone of the plumes.

Those steelhead overwintering in the confluence of the rivers could encounter the 0.1X dilution zone in the nearfield discharge (Figure 5.7). However, the 0.1X dilution zone (25 m from the discharge point) is small relative to the area of the confluence. The area from the point where the rivers converge to the edge of the Action Area was estimated to be 0.44 km2. The nearfield dilution zone was 25m2 ($5.68 \times 10^{-5}$) this zone was calculated to be 0.0057 percent of the Action Area at the confluence. It is unlikely that overwintering steelhead would be exposed to a measurable concentration of focal pollutants in the 0.0057 percent of the occupied area for a duration comparable to the exposure duration required to elicit a response. It is also notable that the north shore of the confluence within the Action Area contains potential wetland areas which may provide more suitable overwintering habitat along with the non-levee shoreline of Clarkston. These areas are 0.5 km and 1.6 km from the point used to model the worst-case discharge plume with CORMIX (section 5.4). These shorelines are vegetated and may provide more complex overwintering habitat further reducing exposure to the 0.1X dilution zone.

EPA expects that out-migrating smolts will preferentially use the vegetated shorelines upstream on the north shore of the Clearwater River (until it becomes hardscaped), the east shore of the Snake River and those shorelines at the confluence in lieu of the rip rap shorelines of Lewiston along the Clearwater and Snake Rivers. EPA acknowledges that smolt will not be able to avoid using the degraded rip raped habitats in the Clearwater River and will likely be exposed to stormwater discharges for short durations in these locations. However, as water temperatures increase in nearshore areas most juvenile salmonids may move away from shallow shoreline areas and disperse offshore. Depending on the flow and the thermal stratification of the River, the offshore repositioning of juveniles may reduce their exposure to stormwater discharges. According to multiple authors in NMFS (2019) *"migrating smolts (including many subyearlings) in the lower Snake River mostly use deeper, faster-flowing, mid-channel or peripheries…"*

Both USACE Reports (2005 and 2018) describe that the levee pond discharges are relatively minor based on the ratios of the pumping rates to the flow of the Clearwater River for water years 1991 to 2004 and 1991 to 2018; these reports present data which show that the flows are less than 0.03 for a 100-year flood/10-year pond discharge, and 0.01 over all quarters and years, respectively. As discussed in Section 5.4.4 and Appendix 1, EPA modeled the discharges as one continuous discharge using CORMIX in efforts to estimate a worst-case stormwater plume and to delineate the near and far-field dilution at the confluence. The model output shows the rate of discharge over distance and provides the estimate of the 0.1X dilution zone. This depiction highlights the size of this dilution zone relative to the area of the confluence within the Action Area and confirms the contribution expressed as a minor localized area (0.0057).

### *5.4.8.b Timing and Duration of Exposure*

Adults overwinter in the Action Area from October through March and migrate through the Action Area from mid-March through December to reach upstream spawning areas. Steelhead of the Snake River DPS are considered summer-run steelhead due to their adult migration pattern. The two runs of adults the A-run and B-run occurs between March and May and August and November, respectively. The A-run DPS is more likely to encounter stormwater discharges due to higher amounts of monthly precipitation and more frequent rainfall than the B-run DPS.

Rearing pre-smolt juveniles may be present in the Action Area throughout the year. Smolts outmigration occurs from April through October. The potential for exposure to the 0.1X dilution zone and stormwater discharges in general was discussed in detail in the previous section. The following section will address the exposure during active migration rather than overwintering.

Migrating adult steelhead may require up to four days travel between the Lower Granite Dam and the confluence of the Snake and Clearwater Rivers and may spend hours or days in the confluence due to cold-water refuges created by the cooler Clearwater River contribution.

A range of mean migrations speeds for adult steelhead of approximately 13 to 33 km/day has been observed. This distance from the confluence of the Snake and Clearwater Rivers and the Lower Granite Dam is approximately 31 miles, or 50 km. Given the mean migration speeds observed in the literature, adult steelhead may require one and a half to four days to travel between the Lower Granite Dam and the confluence (Keefer et al., 2003; Bjornn et al, 2000), at most a half day to travel through the Snake River potion of the Action Area and less through the Clearwater River portion.

Using the available data, we estimated the travel time through the Action Area and the 0.1X dilution zone of the discharge plumes (Table 5.14). According to the exposure estimations adults are expected to swim through the Snake and Clearwater River portions of the Action Area in 0.54 and 0.35 days respectively. They are expected to swim through the 0.1X dilution portion (25 m) of the plumes in 0.05 hrs. These estimates are for steelhead traveling through the Action Area without feeding on their migration to spawn. Because these are empirical data, we assume that resting and holding time are included in the swimming speeds between locations.

We also calculated exposure time for steelhead smolts during outmigration. These calculations were based on travel times of wild steelhead juveniles estimated from the PTAGIS database by NMFS (2003). Juveniles trapped and tagged at a Snake River and a Clearwater River trap from 1990-2003 were detected at the Lower Granite Dam allowing for estimates of travel time. We used the mean of the Snake River and Clearwater River and 99.5 percentile travel times (Table 3.19) as the range for swimming speed from the Lower Granite Dam to the confluence of the Rivers. The final estimates for travel time through the Action Area and the 0.1X dilution zone of the stormwater plume were completed using the slowest (4.65 km/day) swimming speed in order to provide a conservative estimate and because there were caveats associated with these data which compelled a more conservative estimate of exposure.

The results presented in Table 5.14 show that steelhead smolts are expected to travel through the Snake River and Clearwater River over 1.5 day and 0.97 days, respectively. Traveling through the nearfield 0.1X dilution zone portion of the plumes at each discharge location is expected to take 0.13 hrs/location.

#### *5.4.8.c Summary of Exposure*

Two life history behaviors are evident for Snake River steelhead adults and juveniles; these include overwintering in and migrating through the Action Area. As described in Section 5.4.8.a, EPA does not anticipate that overwintering steelhead will encounter the 0.1X dilution zones in the Snake River between Asotin and the confluence due to the distance from the discharge points relative to the deep channel and favorable habitat on the east shore of the River. However, because steelhead are in the Action Area for a significant portion of the year and could encounter discharges, we will discuss this life stage further in the response analysis.

Out-migrating smolts are likely to be exposed to discharges for the limited time they migrate through the Action Area (1 to 1.5 days) and through the 0.1X dilution zone of the stormwater plumes (approximately 0.13 hr). This limited exposure to the plume depends on its intersection with the outmigrants. Habitat in the Action Area is significantly degraded by channel modification, hardscaping and presence of predatory warmwater fish. These factors are likely to influence the use of the shoreline by outmigrants. Considering these factors, we are assuming that smolts outmigrants may be exposed to focal pollutants for a short duration.

We evaluated the response from exposure to focal pollutants for both life stages of steelhead because this species overwinters in the Action Area and thus there is a greater opportunity for them to encounter the discharge plumes.

### 5.4.9 Columbia River Bull Trout

While adult and sub-adult bull trout are present in the Action Area their numbers are limited and therefore there is a low likelihood that individuals would be exposed to stormwater discharges. At the Lower Granite Dam, one bull trout was identified every year or two, indicating that bull trout are present in the upper end of LGDP (in the Snake River) during the spring of at least some years (Bueftner, 2000). Basham (2000) reported that the Idaho Department of Fish and Game smolt trap at Lewiston, Idaho captures an occasional bull trout, at catch rates of no more than one bull trout annually. Bull trout numbers are also limited according to fish ladder counts, only 36 bull trout have been recorded at the lower Granite Dam fish ladder since 2006 (USFWS, 2019b). Between 1998 and 2013 two bull trout were documented in a juvenile bypass structure at the Lower Granite Dam. Monitoring of PIT-tagged bull trout returned three individuals between 2006 and 2011 in the lower Snake River (Barrows et al. 2019; as cited in USFWS, 2019b).

USFWS (2019b) summarizes bull trout presence in the lower Snake River as low densities of individuals, primarily present in winter due to low water temperatures, avoiding areas with limited cover and where predation by larger fish is possible such as near riprap. USFWS (2019b) notes that reservoirs provide abundant food resources for bull trout and that bull trout use of these areas is in the deeper, cooler waters away from armored shorelines. They note that during summer months bull trout may use the deeper portion of the lower Snake and Clearwater Rivers or move to hyporheic zones with cold water upwelling.

#### *5.4.9.a Coincidence with the Discharges*

According to USFWS (2019b) subadult and adult bull trout (following spawning) migrate from their respective subbasins to the mainstem Columbia and lower Snake Rivers during the fall and winter months (i.e., October – February (most common)), or during the spring and early summer (i.e., April – June). Subadult bull trout may stay in the mainstem (assuming Columbia as opposed to lower Snake River) until reaching spawning size, then return to the tributaries. Bull trout do not spawn or rear in the Action Area.

The USFWS (2000) has found little evidence to suggest that bull trout subpopulations use habitat associated with the lower Snake River main-stem dams. Seasonal use of the Snake River by bull trout is likely in upriver tributaries such as the Grande Ronde and Imnaha Rivers, but these areas are substantially upstream of the Action Area (USEPA, 2004). Bull trout migrate through the Action Area to Asotin Creek, which is a major tributary used for spawning (USFWS, 2019b).

Bull trout use of the main-stem Clearwater River is seasonal, as summer water temperatures exceed those used by bull trout (USEPA, 2004). The mainstem Clearwater River provides prey species and migration corridors for adult and subadult bull trout. It also provides connectivity among the Grande Ronde, Salmon, Imnaha, and Snake Rivers and the upper Clearwater basin local populations, although the frequency and intensity of migration between these basins is unknown (USFWS, 2002b).

Migrants from upstream of the LGDP (i.e., from Asotin Creek, and the Grande Ronde, Imnaha, Salmon, and Clearwater Rivers) can also potentially move freely to and from LGDP. However, the USFWS (2000) has found little evidence to suggest that these subpopulations use habitat associated with the lower Snake River main-stem dams. Seasonal use of the Snake River by bull trout is likely in upriver tributaries such as the Grande Ronde and Imnaha Rivers, but these areas are substantially upstream of the Action Area (USEPA, 2004).

Spawning and rearing habitat between the Clearwater/Snake confluence and Lower Granite Dam is limited due to high water temperatures, lack of in-stream woody debris (cover), and poor gravel substrate. The combination of these factors likely results in a low abundance of bull trout in the Action Area.

Not discounting the likelihood of adverse effects, in their evaluation of the USACE Aquatic Pest Management Program biological opinion the USFWS states that: *"... the available information indicates that relatively few bull trout would likely be present in the Action Area during the proposed activities, and those present would be adults or subadults that are mobile and less sensitive to potential adverse effects".*

It has been established that few individuals are expected in the Action Area; those present are adult and subadults foraging, migrating or overwintering in the Snake River; and, that individuals are more likely to be present during winter or use cold water refugia where abundant food resources are available. Based on what is known about bull trout use of the lower Snake and Clearwater Rivers and the quality of that habitat, we anticipate that few bull trout may be present in the lower rivers; rather bull trout may primarily utilize the confluence where the colder water of the Clearwater reduces water temperature and where a more substantial food base is present. USFWS (2019b) describes habitat use by bull trout and that they avoid rip rap shorelines where predation is possible. Both the lower Clearwater and Snake Rivers have extensive rip rap shoreline along the leveed reaches, and presence of predatory fish species in widely documented; therefore, we don't anticipate that bull trout will be exposed to the discharges occurring along the Clearwater and Snake River portions of the Action Area. However, they may be present in the confluence portion of the Action Area.

Since, it is more likely that bull trout will be present in winter their exposure to stormwater discharges will be minimized as levee pond discharges are lowest in winter (Section 5.4.1).

#### *5.4.9.b Timing and Duration of Exposure*

Information to describe bull trout use of the Action Area is very limited, but it is likely that fluvial and adfluvial form of both adults and sub-adults may be present at the confluence of the rivers in winter and when water temperature is within their tolerance. Both adult and subadult life stages are in the Action Area from November to May as bull trout are stenothermal and cannot tolerate elevated water temperatures.

In order to display a worst-case stormwater plume, we incorporated all the discharges into one, and using CORMIX modeled the near and far-field dilution at the confluence (Section 5.4). The model output shows the rate of discharge over distance and provides the estimate of the 0.1X dilution zone. The plume is expected to float except in the extreme nearfield which includes the 0.1X dilution zone; this zone is reached at 25 m from the discharge point.

EPA calculated the percent of the 0.1X dilution zone relative to the entire area within the confluence to the downstream extent of the Action Area. The nearfield dilution zone, where focal pollutants are more likely to be elevated was modeled to be 25m long. We used a 25 m2 0.1X dilution zone, which is wider than the model output to calculate the spatial extent of this area. We determined that it encompasses only 0.0057% within the confluence portion of the Action Area. If adult and sub adult are present at the confluence, they are likely in the deeper portions of the channel and because adults or subadults are mobile it's unlikely that they would be exposed to this small discharge for any length of time, if at all.

Travel time information is lacking for bull trout as limited bull trout have been detected at the Lower Granite Dam. Besides the restrictions of movement caused by the dams and the overall low population status of bull trout in the basin, use of the Action Area is limited by physical habitat conditions.

#### *5.4.9.c Summary of Exposure*

EPA does not expect adult and subadult bull trout to be exposed to stormwater discharges directly through the surface water nor dietary pathways because: 1) bull trout numbers are low reducing the likelihood that any one individual will be will be exposed, 2) they avoid areas with limited cover and where predation by larger fish is possible such as near riprap, 3) both the lower Clearwater and Snake Rivers have extensive rip rap shoreline along the leveed reaches, 4) bull trout use areas in the deeper, cooler waters away from armored shorelines and from the discharges, and 5) adults and subadults that are mobile and can avoid a plume particularly if the temperature is elevated, and 6) exposure to the nearfield dilution zone of the plume is unlikely because it is expected to primarily float, and is an insignificant proportion (0.0057%) of the Action Area within the confluence of the Clearwater and Snake Rivers.

Therefore, bull trout are not expected to be exposed to focal pollutants in the discharge plumes and are not discussed further in this BE.

### 5.4.10 Species Exposure Summary

With the exception of steelhead trout we do not expect that adult salmon or bull trout (adult or sub-adult) will be directly exposed to stormwater discharges primarily because travel time through the Action Area is rapid particularly in the 0.1X dilution zones (25m) of the stormwater plumes; adults migrate through relatively deep main channel, particularly in late summer and fall when discharges are lower when water temperature would be elevated; there is little shoreline vegetation to provide for resting and current breaks; and they do would not be foraging while migrating.

There have been very few documented occurrences of bull trout in the Action Area. Those individuals that may be present avoid areas with limited cover and where predation by larger fish is possible such as near riprap; finally, adults and subadults that are mobile and can avoid a plume particularly if the temperature is elevated.

The species response analysis will focus on adult steelhead trout and the juvenile outmigrants including fall chinook, spring/summer chinook, sockeye salmon and steelhead trout.

## 5.5 SPECIES RESPONSE ANALYSIS

This Section includes an analysis of the response by juvenile Fall Snake River Chinook, juvenile spring/ Summer Snake River Chinook, juvenile Snake River sockeye, and adult and juvenile Snake River steelhead. EPA combined the assessment of all salmonid species together because we were unable to obtain species specific toxicity data and the expectation is that the life histories of these species is similar that the effects would be similar, as well. We also include a response analysis of the prey categories for each of these species and the bull trout.

As discussed in Section 5.1.4, EPA developed the list of focal pollutants based on the data collected by Juul (2004) and Carroll (2005), and the findings of Steevens et al. (2005b). The focal pollutant list (Table 5.1) includes metals, metalloids, and PAHs. We supplemented these data with the stormwater data from the Lewiston Levee Report, Puget Sound Toxics Report, and Western Washington Report (Sections 5.1.1, 5.1.2, and 5.1.3).

EPA was unable to model receiving water concentrations (Section 5.2.4), so a range of dilution factors were used to estimate receiving water concentrations of pollutants (the EPCs). We assumed that the range of dilutions were representative of discharges into the Clearwater River and Snake River during precipitation events in the Fall, Winter and Spring and increased water use in Summer that would trigger stormwater discharges. The resulting EPC range was compared to the SLELs and ECxs (in the case of aluminium) to calculate the HQs. For the majority of focal pollutants, the discharge concentrations are conservative and are likely overestimates of what is actually discharged because we used the geometric mean of the maximum concentration of each focal pollutant, the reporting limit for a data set when the pollutant was undetected, and surrogate data from the Puget Sound Region, a significantly larger urbanized area than the City of Lewiston.

To evaluate the potential impact to ESA-listed salmonids[14], EPA conducted a two-tier analysis. The Tier I analysis focused on those pollutants that had elevated HQs, defined as an HQ greater than 1.0, at EoP concentrations. This conservative approach was designed to ensure that we did not commit a Type II error assuming that exposure to a focal pollutant would not impact a salmonid when in fact it may (e.g. false negative). The Tier II analysis focused on those pollutants with HQs greater than 1.0 in the 0.1X dilution scenario. The uncertainties associated with the use of the data, data gaps and assumptions regarding dilution are presented in Section 5.8.

As a result of these assumptions, the following assessment of the direct effect to ESA-listed salmonids likely overestimates the magnitude of the HQs. The exception to this is aluminum. The stormwater data report aluminum as dissolved while the water quality based ECx values for salmon and bull trout are based on total aluminum. Therefore, the HQs are underestimated by some magnitude which cannot be quantified. Rather than

[14] Data for individual salmonid species were unavailable. Therefore, on SLEL was used for all salmonid/focal pollutant combination, with the exception of aluminum where salmon and bull trout $EC_x$s were calculated.

selecting an arbitrary adjustment factor, EPA presented the calculated HQs with this caveat. Nevertheless, given the significant uncertainties and data gaps (Sections 5.2), no additional modifications to the calculations were made.

### 5.5.1 Tier I Salmonid Assessment

EPA's Tier I salmonid assessment (described in Section 5.3.5.a) was conducted for all of the focal pollutants (Table 5.1). However, only thirteen (13) focal pollutants had elevated HQs (greater than 1.0) at EoP concentrations and are presented in Table 5.15. These focal pollutants consist of seven metals/metalloids and six PAHs. The EoP HQs range from 1.1 to 41.2 with the majority exceeding in Basin 13 (Downtown). The Downtown basin consists of commercial (54%), high density (28%), and low density (13%) with a minimum (5%) open space land use types. presents the results of this assessment.

Of these 13 focal pollutants, only total inorganic mercury was evaluated in the Tier II assessment for direct effects to ESA-Listed salmonids because the 0.1X dilution HQ of 4.1 exceeded the trigger HQ of 1.0. The remaining focal pollutants were not considered further for ESA-listed salmonids.

***Table 5.15. Results of the Tier I assessment for ESA-listed salmonids based on the geometric mean of the maximum values of the focal pollutants.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| **Basin #1** | | | | | | |
| Copper, dissolved | 5.75 | 2.68 | **2.15** | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | **2.33** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.50 | 0.28 | **1.77** | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | **2.19** | 0.22 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **41.9** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 38.66 | 36 | **1.07** | 0.11 | 0.01 | 0.00 |
| **Basin #2** | | | | | | |
| Aluminum, dissolved | 252 | | | | 0.02 | 0.00 |
| Copper, dissolved | 5.75 | 2.68 | **2.15** | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | **2.33** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.50 | 0.28 | **1.77** | 0.18 | 0.02 | 0.00 |
| Iron, dissolved | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | **2.19** | 0.22 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **41.9** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 38.66 | 36 | **1.07** | 0.11 | 0.01 | 0.00 |
| **Basin #3** | | | | | | |
| Benzo(g,h,i)perylene | 0.56 | 0.44 | **1.26** | 0.13 | 0.01 | 0.00 |
| Copper, dissolved | 6.47 | 2.68 | **2.42** | 0.24 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | **2.33** | 0.23 | 0.02 | 0.00 |

***Table 5.15. Results of the Tier I assessment for ESA-listed salmonids based on the geometric mean of the maximum values of the focal pollutants.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Indeno(1,2,3-cd)pyrene | 0.62 | 0.28 | **2.20** | 0.22 | 0.02 | 0.00 |
| Iron,total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.34 | 0.5 | **2.67** | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **42.2** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 53.16 | 36 | **1.48** | 0.15 | 0.01 | 0.00 |
| **Basin #4** | | | | | | |
| Benzo(g,h,i)perylene | 0.47 | 0.44 | **1.07** | 0.11 | 0.01 | 0.00 |
| Copper, dissolved | 6.13 | 2.68 | **2.29** | 0.23 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.49 | 0.2825 | **1.74** | 0.17 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.51 | 0.28 | **1.83** | 0.18 | 0.02 | 0.00 |
| Iron, total | 486 | 1318 | **3.71** | 0.37 | 0.04 | 0.00 |
| Lead, dissolved | 1.22 | 0.5 | **2.43** | 0.24 | 0.02 | 0.00 |
| Mercury, total | 0.07 | 0.002 | **36.2** | **3.6** | 0.4 | 0.03 |
| Zinc, dissolved | 48.14 | 36 | **1.34** | 0.13 | 0.01 | 0.00 |
| **Basin #5** | | | | | | |
| Copper, dissolved | 5.75 | 2.68 | **2.15** | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | **2.33** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.50 | 0.28 | **1.77** | 0.18 | 0.02 | 0.00 |
| Iron,total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | **2.19** | 0.22 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **41.9** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 38.66 | 36 | **1.07** | 0.11 | 0.01 | 0.00 |
| **Basin #6** | | | | | | |
| Benzo(b)fluoranthene | 0.95 | 0.68 | **1.40** | 0.14 | 0.01 | 0.00 |
| Benzo(g,h,i)perylene | 0.90 | 0.44 | **2.04** | 0.20 | 0.02 | 0.00 |
| Benzo(k)fluoranthene | 0.71 | 0.64 | **1.10** | 0.11 | 0.01 | 0.00 |
| Copper, dissolved | 8.28 | 2.68 | **3.09** | 0.31 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.67 | 0.2825 | **2.36** | 0.24 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.92 | 0.28 | **3.30** | 0.33 | 0.03 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.95 | 0.5 | **3.90** | 0.39 | 0.04 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **42.9** | **4.3** | 0.4 | 0.04 |
| Zinc, dissolved | 88.30 | 36 | **2.45** | 0.25 | 0.02 | 0.00 |
| **Basin #7** | | | | | | |
| Benzo(b)fluoranthene | 0.83 | 0.68 | **1.22** | 0.12 | 0.01 | 0.00 |
| Benzo(g,h,i)perylene | 0.79 | 0.44 | **1.79** | 0.18 | 0.02 | 0.00 |
| Copper, dissolved | 7.77 | 2.68 | **2.90** | 0.29 | 0.03 | 0.00 |

***Table 5.15. Results of the Tier I assessment for ESA-listed salmonids based on the geometric mean of the maximum values of the focal pollutants.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | **2.33** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.83 | 0.28 | **2.95** | 0.30 | 0.03 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.76 | 0.5 | **3.53** | 0.35 | 0.04 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **42.8** | **4.3** | 0.4 | 0.04 |
| Zinc, dissolved | 79.42 | 36 | **2.21** | 0.22 | 0.02 | 0.00 |
| **Basin #8** | | | | | | |
| Copper, dissolved | 5.75 | 2.68 | **2.15** | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | **2.33** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.50 | 0.28 | **1.77** | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | **2.19** | 0.22 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **41.9** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 38.66 | 36 | **1.07** | 0.11 | 0.01 | 0.00 |
| **Basin #9** | | | | | | |
| Copper, dissolved | 5.15 | 2.68 | **1.92** | 0.19 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.57 | 0.2825 | **2.00** | 0.20 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.43 | 0.28 | **1.52** | 0.15 | 0.02 | 0.00 |
| Iron, total | 5668.72 | 1318 | **4.30** | 0.43 | 0.04 | 0.00 |
| Lead, dissolved | 0.96 | 0.5 | **1.93** | 0.19 | 0.02 | 0.00 |
| Mercury, total | 0.07 | 0.002 | **36.9** | **3.7** | 0.4 | 0.03 |
| **Basin #10** | | | | | | |
| Benzo(g,h,i)perylene | 0.54 | 0.44 | **1.23** | 0.12 | 0.01 | 0.00 |
| Copper, dissolved | 6.70 | 2.68 | **2.50** | 0.25 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.64 | 0.2825 | **2.25** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.60 | 0.28 | **2.16** | 0.22 | 0.02 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.35 | 0.5 | **2.69** | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **42.4** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 61.84 | 36 | **1.72** | 0.17 | 0.02 | 0.00 |
| **Basin #11** | | | | | | |
| Benzo(g,h,i)perylene | 0.55 | 0.44 | **1.24** | 0.12 | 0.01 | 0.00 |
| Copper, dissolved | 6.63 | 2.68 | **2.47** | 0.25 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.64 | 0.2825 | **2.28** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.61 | 0.28 | **2.17** | 0.22 | 0.02 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.34 | 0.5 | **2.69** | 0.27 | 0.03 | 0.00 |

***Table 5.15. Results of the Tier I assessment for ESA-listed salmonids based on the geometric mean of the maximum values of the focal pollutants.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Mercury, total | 0.08 | 0.002 | **42.3** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 58.95 | 36 | **1.64** | 0.16 | 0.02 | 0.00 |
| **Basin #12** | | | | | | |
| Copper, dissolved | 6.66 | 2.68 | **2.49** | 0.25 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.57 | 0.2825 | **2.00** | 0.20 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.45 | 0.28 | **1.62** | 0.16 | 0.02 | 0.00 |
| Iron, dissolved | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.14 | 0.5 | **2.28** | 0.23 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **42.5** | **4.3** | 0.4 | 0.04 |
| Zinc, dissolved | 73.39 | 36 | **2.04** | 0.20 | 0.02 | 0.00 |
| **Basin #13** | | | | | | |
| Benzo(a)pyrene | 1.08 | 0.96 | **1.13** | 0.11 | 0.01 | 0.00 |
| Benzo(b)fluoranthene | 1.24 | 0.68 | **1.82** | 0.18 | 0.02 | 0.00 |
| Benzo(g,h,i)perylene | 1.14 | 0.44 | **2.59** | 0.26 | 0.03 | 0.00 |
| Benzo(k)fluoranthene | 0.88 | 0.64 | **1.37** | 0.14 | 0.01 | 0.00 |
| Copper, dissolved | 9.19 | 2.68 | **3.43** | 0.34 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.67 | 0.2825 | **2.38** | 0.24 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 1.14 | 0.28 | **4.07** | 0.41 | 0.04 | 0.00 |
| Iron, total | 6313.06 | 1318 | **4.79** | 0.48 | 0.05 | 0.00 |
| Lead, dissolved | 2.35 | 0.5 | **4.70** | 0.47 | 0.05 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **42.2** | **4.2** | 0.4 | 0.04 |
| Zinc, dissolved | 100.86 | 36 | **2.80** | 0.28 | 0.03 | 0.00 |
| **Basin #14** | | | | | | |
| Benzo(g,h,i)perylene | 0.49 | 0.44 | **1.11** | 0.11 | 0.01 | 0.00 |
| Copper, dissolved | 6.64 | 2.68 | **2.48** | 0.25 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.57 | 0.2825 | **2.01** | 0.20 | 0.02 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.55 | 0.28 | **1.96** | 0.20 | 0.02 | 0.00 |
| Iron, total | 6051.28 | 1318 | **4.59** | 0.46 | 0.05 | 0.00 |
| Lead, dissolved | 1.28 | 0.5 | **2.57** | 0.26 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **40.5** | **4.0** | 0.4 | 0.04 |
| Zinc, dissolved | 63.75 | 36 | **1.77** | 0.18 | 0.02 | 0.00 |
| **Basin #15** | | | | | | |
| Benzo(g,h,i)perylene | 0.57 | 0.44 | **1.29** | 0.13 | 0.01 | 0.00 |
| Cadmium, dissolved | 0.22 | 0.15 | **1.48** | 0.15 | 0.01 | 0.00 |
| Copper, dissolved | 6.78 | 2.68 | **2.53** | 0.25 | 0.03 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.54 | 0.28 | **1.92** | 0.19 | 0.02 | 0.00 |
| Iron, dissolved | 6021.35 | 1318 | **4.57** | 0.46 | 0.05 | 0.00 |

***Table 5.15. Results of the Tier I assessment for ESA-listed salmonids based on the geometric mean of the maximum values of the focal pollutants.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Lead, dissolved | 1.76 | 0.5 | **3.51** | 0.35 | 0.04 | 0.00 |
| Mercury, dissolved | 0.06 | 0.002 | **27.24** | **2.72** | 0.27 | 0.03 |
| Zinc, dissolved | 72.74 | 36 | **2.02** | 0.20 | 0.02 | 0.00 |
| **Basin #16** | | | | | | |
| **Basin #17** | | | | | | |
| **Basin #18** | | | | | | |
| Benzo(g,h,i)perylene | 0.57 | 0.44 | **1.29** | 0.13 | 0.01 | 0.00 |
| Cadmium, dissolved | 0.24 | 0.15 | **1.63** | 0.16 | 0.02 | 0.00 |
| Copper, dissolved | 6.86 | 2.68 | **2.56** | 0.26 | 0.03 | 0.00 |
| Indeno(1,2,3-cd)pyrene | 0.54 | 0.28 | **1.91** | 0.19 | 0.02 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.81 | 0.5 | **3.63** | 0.36 | 0.04 | 0.00 |
| Mercury, total | 0.06 | 0.002 | **29.3** | **2.9** | 0.3 | 0.03 |
| Zinc, dissolved | 76.85 | 36 | **2.13** | 0.21 | 0.02 | 0.00 |
| **Basin #19** | | | | | | |
| Benzo(b)fluoranthene | 0.91 | 0.68 | **1.33** | 0.13 | 0.01 | 0.00 |
| Benzo(g,h,i)perylene | 0.87 | 0.44 | **1.99** | 0.20 | 0.02 | 0.00 |
| Benzo(k)fluoranthene | 0.67 | 0.64 | **1.05** | 0.11 | 0.01 | 0.00 |
| Cadmium, dissolved | 0.16 | 0.15 | **1.06** | 0.11 | 0.01 | 0.00 |
| Copper, dissolved | 7.69 | 2.68 | **2.87** | 0.29 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.60 | 0.2825 | **2.12** | 0.21 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.88 | 0.28 | **3.16** | 0.32 | 0.03 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.94 | 0.5 | **3.88** | 0.39 | 0.04 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **40.0** | **4.0** | 0.4 | 0.04 |
| Zinc, dissolved | 72.43 | 36 | **2.01** | 0.20 | 0.02 | 0.00 |
| **Basin #20** | | | | | | |
| Copper, dissolved | 5.75 | 2.68 | **2.15** | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | **2.33** | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.50 | 0.28 | **1.77** | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 1318 | **5.02** | 0.50 | 0.05 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | **2.19** | 0.22 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.002 | **41.9** | **4.0** | 0.4 | 0.04 |
| Zinc, dissolved | 38.66 | 36 | **1.07** | 0.11 | 0.01 | 0.00 |

As evident from the Tier I assessment, only THg had HQ > 1.0 in the 0.1X dilution which was the trigger for completing a Tier II analysis using more realistic (less conservative) EPCs for the Basins. Mercury HQs are elevated from all Basins, with the highest in Area 370 (Lindsey Creek and Basin 13 (West End Levee Pond). The HDR land use type generated the highest mercury discharge EPCs. Basins 12, 13 and 14 contain the highest percentage of HDR compared to the other Basins and discharged from the West Levee Pond.

EPA notes that the magnitude of the HQ is underestimated for dissolved aluminum. The $EC_x$s are based on toxicity tests using or adjusting for total aluminum allowing for a direct comparison to the aluminum 304(a) criteria. However, the site-specific stormwater data report aluminum as dissolved and therefore underreport by some proportion the exposure concentration. The degree to which the aluminum EPC is underestimated relates to the proportion of the dissolved fraction to total aluminum in stormwater samples. EPA has no way of knowing what this proportion is, as the data were not reported for total aluminum therefore, EPA did not apply an arbitrary multiplier. Moreover, the $EC_x$s were generated using the data collected by the USGS over decades at the Clearwater River Station at Spalding. A more direct comparison would be made by using the pH, DOC and total hardness from the site-specific stormwater data; however, these water quality parameters were not measured in these samples collected in 2004 and 2005. Consequently, the comparison of the $EC_x$s to the stormwater data is a significant source of uncertainty in the hazard analysis.

The HQs presented in Table 5.16 were calculated by dividing the basin-specific maximum EoP and 0.1X aluminum concentrations by the $EC_x$s for salmon and bull trout ($EC_x$ values are presented in Table 5.7).

***Table 5.16. Comparison of Salmon and Bull Trout Hazard Quotients (HQs) based on Water Quality-Based Effect Concentrations ($EC_X$) with the Maximum Aluminum Concentration in Each Basin.***

| Basin | Aluminum Concentration (µg/L) | Salmon | | | | | | Bull Trout | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $EC_{15}$ | | $EC_{10}$ | | $EC_5$ | | $EC_{15}$ | | $EC_{10}$ | | $EC_5$ | |
| | | HQ EoP | 0.1X HQ | HQ EoP | 0.1X HQ | HQ EoP | HQ 0.1X | HQ EoP | HQ 0.1X | HQ EoP | HQ 0.1X | HQ EoP | HQ 0.1X |
| **1** | **252** | 1.2 | 0.1 | 1.4 | 0.1 | 1.8 | 0.2 | 1.0 | 0.1 | 1.1 | 0.1 | 1.5 | 0.1 |
| **2** | **252** | 1.2 | 0.1 | 1.4 | 0.1 | 1.8 | 0.2 | 1.0 | 0.1 | 1.1 | 0.1 | 1.5 | 0.1 |
| **3** | **243** | 1.1 | 0.1 | 1.3 | 0.1 | 1.7 | 0.2 | 0.9 | 0.1 | 1.1 | 0.1 | 1.4 | 0.1 |
| **4** | **358** | 1.7 | 0.2 | 2.0 | 0.2 | 2.5 | 0.3 | 1.4 | 0.1 | 1.6 | 0.2 | 2.1 | 0.2 |
| **5** | **252** | 1.2 | 0.1 | 1.4 | 0.1 | 1.8 | 0.2 | 1.0 | 0.1 | 1.1 | 0.1 | 1.5 | 0.1 |
| **6** | **220** | 1.0 | 0.1 | 1.2 | 0.1 | 1.6 | 0.2 | 0.9 | 0.1 | 1.0 | 0.1 | 1.3 | 0.1 |
| **7** | **227** | 1.1 | 0.1 | 1.2 | 0.1 | 1.6 | 0.2 | 0.9 | 0.1 | 1.0 | 0.1 | 1.3 | 0.1 |
| **8** | **252** | 1.2 | 0.1 | 1.4 | 0.1 | 1.8 | 0.2 | 1.0 | 0.1 | 1.1 | 0.1 | 1.5 | 0.1 |
| **9** | **255** | 1.2 | 0.1 | 1.4 | 0.1 | 1.8 | 0.2 | 1.0 | 0.1 | 1.2 | 0.1 | 0.5 | 0.1 |
| **10** | **243** | 1.1 | 0.1 | 1.3 | 0.1 | 1.7 | 0.2 | 0.9 | 0.1 | 1.1 | 0.1 | 1.4 | 0.1 |
| **11** | **243** | 1.1 | 0.1 | 1.3 | 0.1 | 1.7 | 0.2 | 0.9 | 0.1 | 1.1 | 0.1 | 1.4 | 0.1 |
| **12** | **252** | 1.2 | 0.1 | 1.4 | 0.1 | 1.8 | 0.2 | 1.0 | 0.1 | 1.1 | 0.1 | 1.5 | 0.1 |
| **13** | **224** | 1.1 | 0.1 | 1.2 | 0.1 | 1.6 | 0.2 | 0.9 | 0.1 | 1.0 | 0.1 | 1.3 | 0.1 |
| **14** | **282** | 1.3 | 0.1 | 1.6 | 0.2 | 2.0 | 0.2 | 1.1 | 0.1 | 1.3 | 0.1 | 1.6 | 0.2 |
| **15** | **211** | 1.0 | 0.1 | 1.2 | 0.1 | 1.5 | 0.1 | 0.8 | 0.1 | 1.0 | 0.1 | 1.2 | 0.1 |
| **18** | **163** | 0.8 | 0.1 | 0.9 | 0.1 | 1.2 | 0.1 | 0.7 | 0.1 | 1.0 | 0.1 | 1.0 | 0.1 |
| **19** | **207** | 1.0 | 0.1 | 1.1 | 0.1 | 1.5 | 0.1 | 0.8 | 0.1 | 0.9 | 0.1 | 1.2 | 0.1 |
| **20** | **252** | 1.2 | 0.1 | 1.4 | 0.1 | 1.8 | 0.2 | 1.0 | 0.1 | 1.1 | 0.1 | 1.5 | 0.1 |

### 5.5.2 Tier II Salmonid Assessment

The Tier II assessment included reasonable worst-case EPCs to evaluate direct exposure of ESA-listed salmonids to total inorganic mercury at the 0.1X dilution. EPA recalculated predicted EPCs and HQs to support this analysis and considered background mercury levels in the Action Area and potential reductions in mercury loading as a result of implementing the Permits.

#### *5.5.2.a Tier II Total Mercury Exposure Point Concentrations*

To calculate the reasonable, worst-case EPCs for total inorganic mercury, EPA slightly modified the methodology described in Section 5.2. EPA kept the aggregated datasets based on land use as described previously, however, instead of analyzing the maximum values from each report, EPA considered all data within a particular land dataset. Any non-detects were substituted with the maximum reported value. An estimation of THg concentration in runoff of a given land Y, use is now given by the following equation:

$$total\ mercury_Y = \sqrt[n]{x_1 * x_2 * \ldots * x_n}$$

Where $x_1$ the first reported concentration of THg or total iron for land use *Y*, and *n* is the number of reported values. The same process of estimating pollutant concentrations in runoff from each basin was used. Taking the geometric mean of all data within a land use classification, instead of only the maximum data points, offers a less conservative and more realistic analysis of THg concentrations in MS4 discharges within the Action Area. Table 5.17 presents the mercury concentration used in the Tier I and Tier II assessments. The revised estimated mercury concentrations in the Tier II approach represent an average reduction in concentration of 57.6 percent.

***Table 5.17: Predicted basin-specific total inorganic mercury end of pipe concentrations and associated summary statistics comparison between Tier I and Tier II concentrations***

| Basin | Estimated EPCs at EoP (µg/L) | |
|---|---|---|
| | **Tier I** | **Tier II** |
| 1-3, 5, 8, 13, and 20 | 0.084 | 0.035 |
| 4 | 0.072 | 0.028 |
| 6-7 | 0.086 | 0.034 |
| 9 | 0.074 | 0.031 |
| 10 – 12 | 0.085 | 0.036 |
| 14 | 0.081 | 0.034 |
| 15 | 0.059 | 0.025 |
| 18 | 0.059 | 0.027 |
| 19 | 0.080 | 0.032 |
| **Summary Statistics** | | |
| Min | 0.059 | 0.022 |
| Max | 0.086 | 0.037 |
| Geomean | 0.080 | 0.033 |

| | | |
|---|---|---|
| Range | 0.027 | 0.015 |
| STD | 0.009 | 0.003 |
| Upper CI | 0.083 | 0.035 |
| Lower CI | 0.076 | 0.032 |
| Percent Change | 57.6% | |
| Note: No predicted stormwater runoff from Basins 16 and 17 | | |

### *5.5.2.b Background Mercury in the Action Area*

The Interim RPA for mercury is comparable to the background mercury level in the Action Area, therefore, to contextualize the magnitude of the HQs, we substitute the background concentrations for EPCs to calculate the background HQs. We then discuss the magnitude of these those generated using the MS4 discharges.

Mercury (Hg) is a pollutant of global concern due to its wide distribution via the atmosphere and subsequent deposition in remote/pristine locations (Fitzgerald et al., 1998; Trip and Allan, 2000; Van Furl et al., 2010; Watras and Morrison, 2008). As a result of global anthropogenic activities the amount of mercury in “background” locations throughout the world is on average 3-fold above pre-industrial concentrations (Mason et al., 2012; Obrist et al., 2018). Average total mercury concentrations in precipitation across Idaho are 11.7 ±4.0 ng/L (National Atmospheric Deposition Program, 2012); however, because watershed soils are an efficient sink for Hg deposition, less than 10% of this mercury is typically exported in runoff (Domagalski et al., 2016). An extensive survey of total mercury concentrations in rivers and streams throughout the US (n=250 samples) showed that the median value from watersheds without mining activities was 1.9 ng/L (Scudder, 2009). This value provides a good estimate of typical national background stream/river concentrations—but does not provide specific data from the State of Idaho or Lewiston area.

The total mercury concentrations in Idaho rivers have been measured in several studies. For example, total mercury concentrations from the Snake River (within Brownlee Reservoir) upstream of Lewiston have average ±standard deviation concentrations of 1.5 ± 0.6 ng/L (n=24) (Fosness et al., 2013). Similar average concentrations have been measured further upstream in the Snake River and Boise Rivers: 1.5 ±1.9 ng/L (n=18) (MacCoy and Mebane, 2018). The watersheds associated with these sample locations contain some anthropogenic activities (i.e. agriculture, urban areas), but in general the mercury in these waterways is considered to mostly originate from atmospheric deposition. However, in addition to global-pool atmospheric sources, this area may experience enhanced deposition from some regional mercury sources (Essig, 2010).

To provide a more representative “background” concentration of total mercury, IDEQ and the USGS conducted a spatially extensive survey of total mercury concentrations in 40 rivers/streams throughout Idaho in 2008 (Essig, 2010). With the exceptions of three locations on the Coeur d’Alene River which were impacted by historical mining sources, the average from all of the other locations was 0.80 ± 0.42 ng/L (n=37) (Table 5.18; Essig, 2010). This average is lower than the national streams value of 1.9 ng/L and the

1.5 ng/L concentrations from studies of the Snake and Boise Rivers, and less than 10% of the average atmospheric deposition concentrations. As such, it can be considered a good representative of background total mercury concentration in the state of Idaho (Table 5.18).

***Table 5.18. Background Concentrations of Mercury Nationwide, in Idaho and Representative of the Action Area***

| National Rivers and Streams | Snake River | Snake River/ Boise River | Throughout Idaho |
|---|---|---|---|
| Median 1.9 ng /L | 1.5 ± 0.6 ng/L | 1.5 ± 1.9 ng/L | 0.8 ±0.42 ng/L |
| N=250 | N=24 | N=18 | N=37 |

The mercury background concentrations including the National Rivers and Streams, the Snake River within Brownlee Reservoir and further upstream in the Snake River and Boise Rivers are comparable (1.5 ng/L) to the Interim RPA of 2.0 ng/L. The upper bound HQs in the Snake River and Snake River/Boise River are also above 1.0, in fact the latter HQ is equivalent to the upper bound HQ for the Action Area.

When using these background concentrations to generate HQs, on average the Action Area results in the highest HQ[15], but the variability in the HQs in the Action Area is lower than the background data sets. The magnitude of the mean HQs using background as the EPC range from 0.4 to 0.95, while the HQs for the Action Area range from 1.2 to 1.5 (Table 5.19).

The Action Area mean HQs exceed the mean background HQs by at most 73% (throughout Idaho) and at least by 50%, however the upper bound background HQs exceed 1.0 in the Snake and Boise Rivers and are equivalent to the upper bound HQ for the Action Area. Therefore, while the HQs are elevated in the Action Area, they correspond with background HQs.

***Table 5.19. Comparison between the Hazard Quotients calculated for the Action Area (sans BMPs) and Background Mercury***

| Location | Background (ng/L) | | | Hazard Quotients | | |
|---|---|---|---|---|---|---|
| | Mean | Lower Bound | Upper Bound | Mean | Lower Bound | Upper Bound |
| Action Area | NA | NA | NA | 1.5 – 1.2 | 1.4 – 1.1 | 1.7 – 1.4 |
| Snake River/Boise River | 1.5 | -0.4 | 3.4 | 0.75 | -0.20 | 1.70 |
| National Rivers and Streams | 1.9 | NA | NA | 0.95 | | |
| Snake River | 1.5 | 0.9 | 2.1 | 0.75 | 0.45 | 1.05 |
| Throughout Idaho | 0.8 | 0.38 | 1.22 | 0.40 | 0.19 | 0.61 |

*NA - Not available*

The 2018 USACE reports present the results of the comparison of the Lewiston Levee interior drainage area pumping rates and the Clearwater River flows (Table 5.12). The

[15] The 0.1X dilution zone with BMP Effectiveness

USACE reported that the "results indicate that this ratio was less than 0.01 for 99% of the annual record between water years 1991 and 2018, with a maximum ratio of 0.0146, a mean ratio of 0.0016 (±0.002). If contribution from the levee drainage area (which is the majority of the basin) in less than 1% of the River flow and the background mercury is 0.8 ng /L (±0.42 ng/L) then the contribution of mercury from the levee pond discharges would translate to 0.008 ng/L in the River. Thus, the contribution of total inorganic mercury from the levee pond discharges does not result in a measurable change in the background.

### *5.5.2.c Estimated Total Mercury Loading in Stormwater Runoff*

EPA calculated the loading of mercury for all discharge points in the Clearwater and Snake River from two representative storm events (see Section 5.2.4). The total amount of mercury contributed during a 24 hr and 6 hr storm event was predicted to be 0.003 lbs and 0.011 lbs, respectively (Table 5.20). This includes the north and west levee ponds discharges, which constitutes approximately 1/3rd of the total load ( 0.001 lbs and 0.003 lbs) to the Clearwater River; the addition of the 380 structure, Snake River and Lindsey Creek amounts to 2/3rd of the cumulative total mercury loading to the rivers.

***Table 5.20 Total Mercury Loading for all Discharge Locations During Representative Storm Events***

| **Location** | **2-yr, 6 hr (lbs)** | **2 yr, 24-hr (lbs)** |
|---|---|---|
| 380 Structure drainage tunnel | 0.0011 | 0.0032 |
| Snake River | 0.0006 | 0.0031 |
| North Levee Pond | 0.0003 | 0.0007 |
| West Levee Pond | 0.0007 | 0.0021 |
| Lindsey Creek | 0.0004 | 0.0018 |
| **Total** | **3.1E-03** | **1.1E-02** |

The USACE has reported that the total discharges from the north, east and west levee ponds constitute less than 0.01 of the flow of the Clearwater River (Table 5.12 and Table 5.13), we assume that the loading of mercury is comparable. Note that EPA's loading analysis does not include the East Levee Pond, since that is outside of the Action Area, however, we include the Snake River, Lindsey Creek and the 380-drainage structure. The loading to the Snake River is 6.0 E$^{-}$4lbs (3.0 E$^{-}$4 kg) and 3.1 E$^{-}$3lbs (1.0 E$^{-}$3 kg) for the 2-yr 6hr and 24 hr storm events. The loading to the Clearwater River is 2.5 E$^{-}$3 (1.1 E$^{-}$3) and 7.8E-3lbs (3.5 E$^{-}$3 kg). Given that the flow from the north, east and west levee ponds constitutes less that 0.1 of the flow of the Clearwater River this loading of total mercury and any bioaccumulation of the methylated form would be immeasurable.

As stated in Section 5.4., EPA did not conduct a bioaccumulation analysis and this decision was further supported evaluating loading of total mercury and calculating the loading (less than 0.25 oz collectively for the 2-yr 6 hr and 24 hr storms over the entire action area). EPA concluded that although total mercury is added to the environmental baseline it would be challenging to reliably demonstrate a measurable effect via the food web pathway caused by the proposed action. Therefore, we evaluated the direct effects from potential exposure via the water column.

#### *5.5.2.d Mercury Reductions due to Permit Implementation*

As discussed in Section 2.2.4, the Permits require the City, LCSC and ITD2 to use both structural and non-structural BMPs that are known to reduce pollutants in MS4 discharges. When structural stormwater control measures are appropriately designed, operated, and maintained, and then combined with full implementation of appropriate non-structural source control measures to the maximum extent practicable, the accumulative benefit of using both structural and nonstructural practices is broadly recognized to result in water quality improvement (USEPA, 1999b; USEPA, 2001; IDEQ, 2020).

EPA conducted a conservative risk-based analysis to assess the potential adverse effect of stormwater pollutants on listed species present within the Action Area. Of the 38 pollutants (20 metals and 18 PAHs) evaluated in the BE, only total mercury resulted in an elevated hazard quotient after dilution (0.1X). The HQ analysis does not account for the intermittent nature of stormwater runoff events, nor the likely reduction in pollutant concentration present in the runoff during a storm event (i.e. that a pollutant is not discharged at a continuous concentration during a storm event). Furthermore, the HQs presented in the BE do not account for potential pollutant reductions as a result of implementing the Permits. As such, the following discussion describes how mercury is transported in stormwater runoff, the BMPs that could result in a reduction in mercury stormwater, and the revised HQ calculations that account for this reduction.

Mercury can exist in dissolved and particulate-bound fractions, with the latter typically being the dominant form in urban settings, especially during periods of stormwater runoff. Several studies have shown that mercury levels in urban and agricultural stormwater runoff are strongly correlated with suspended particles (Gilbreath, 2012; Lawson et al., 2001; Eckley and Branfireun, 2008; Hurley et al., 1998, David et al, 2009).

Numerous studies have documented that mercury loads in stormwater runoff are highest in discharges from industrial and commercial land uses in urbanized areas (Gilbreath, 2012; Mangarella et al, 2010; Wentz, 2014). Absent legacy sources of mercury near the urbanized area (e.g. chlor-alkali facilities, chemical manufacturing) and as discussed in Section 5.5.2.b., atmospheric deposition can be an important source of mercury loading at the watershed level and that elevated rates of atmospheric deposition can occur in urban watersheds (Van Metre and Mahler, 2003; Van Metre, 2012; Mangarella, et al 2010; Wentz, 2014). Anthrophonic releases of mercury are estimated to have increased the global background mercury concentrations more than 3-fold compared to pre-industrial levels (Amos et al., 2013; Biester et al., 2007; Mason et al., 1994). As a result, when using the background mercury concentrations as the EPC and calculating the HQ, other locations within the Snake and Boise Rivers show elevated HQ (absent the proposed action) (Table 5.19). Because background mercury concentrations are elevated due to global-pool deposition, the Interim RPA for total mercury (2ng/L) can be close to background concentrations. One important factor mitigating the degree to which atmospherically deposited mercury enters aquatic systems is the land use activity occurring within a watershed—with urban and agricultural landscapes typically mobilizing a greater portion of atmospherically deposited mercury in runoff than forested watersheds (Domagalski et al., 2016; Hsu-Kim et al., 2018).

Despite the level of water quality impairments that mercury can cause, there are limited monitoring data available that evaluates mercury removal efficiencies as a result of implementing urban stormwater BMPs. Yee and McKee (2010) conducted a series of settling column experiments using stormwater runoff and sediment samples collected from urban watersheds in the San Francisco Bay area. They found that 10 to 28% of mercury entrained in stormwater settled out within 20 minutes, and 89 to 99% of mercury re-suspended from creek sediments also settled out within 20 minutes. Based on these experiments, Yee and McKee concluded that mercury behaved very much like a sediment particle, and that any urban BMP that promoted settling of fine sediment particles or captured fine-grained street solids (e.g., street cleaning) should be effective at reducing mercury loads in urban watersheds.

Monson (2007) monitored the effect of 10 constructed wetlands in Minnesota to remove mercury in urban stormwater runoff and found that they were extremely effective in trapping and retaining mercury inputs (e.g., 80 to 90% removal, primarily due to particle sedimentation).

Mangarella et al (2010) performed an extensive analysis of mercury reduction strategies for urban watersheds in the San Francisco Bay area. They concluded that two pollution prevention practices – recycling of thermostats and fluorescent bulbs – could help reduce urban mercury loads. Mangarella et al (2010) also determined that stormwater retrofits and street cleaning efforts targeted at commercial, industrial and redevelopment sites also showed a moderate capability to reduce urban mercury loads.

Therefore, it is reasonable to assume that mercury concentrations should be reduced by stormwater BMPs that are designed to reduce suspended solids and particulate loading and applicable pollution prevention practices, such as improved source control measures (e.g. recycling of mercury-containing equipment) and maintenance of stormwater assets (e.g. street sweeping and drop inlet cleaning).

Based on the effectiveness of the stormwater management control measures to be implemented by the Permittees, coupled with EPA’s current understanding of the MS4 infrastructure owned and/or operated by the Permittees, EPA expects that Permittees compliance with the Permit will sufficiently reduce sediment and particulate loading, and by extension mercury, discharged through the MS4s during the Permit term and will not cause or contribute to an excursion above the applicable Idaho Water Quality Standards.

### *5.5.2.e Tier II Salmonid Hazard Quotients for Mercury*

As discussed in Section 5.3.5, EPA developed HQs to represent the potential adverse effect of stormwater pollutants on listed species present within the Action Area, which are a function of the predicted exposure point concentration and the lowest effect level. For mercury, EPA conducted a Tier II assessment to evaluate impacts to salmonids based on the geometric mean of the predicted EPC (see Table 5.17). To consider the beneficial effects of issuing the MS4 permit, EPA has recalculated the mercury HQs to account for the 10% and 28% reduction in the particulate-bound mercury, which ranges from 60 % to 70 % of the total mercury. These reductions are anticipated to result from the beneficial effects of implementing stormwater BMPs. Since the BMPs would not reduce the volume of the stormwater discharge, EPA assumes that the documented reduction in load would result in the same reduction in the concentration in the water.

The variability of the HQs for the Tier II mercury analysis is low with a mean of 1.7 ± 0.17. Additionally, when incorporating the estimated BMP reduction levels (described in Section 5.5.2.d) to the HQ calculations, results in a concomitant 10% and 28% reduction in mean HQs, 1.6 (1.2 - 1.8) and 1.2 (1.1 – 1.6), respectively (Table 5.21 and Table 5.22). The magnitude of the HQs is reduced when considering the beneficial effects of the action, which are expected to reduce the concentration and loading of total mercury in the Action Area. While the HQs are above parity (Figure 5.8) they are not elevated at a level that would result in a significant risk to ESA-listed salmonids. This conclusion is made considering more realistic assumptions of exposure, both spatially and temporally, as discussed in Appendix 1) and Section 5.5.

***Table 5.21. Salmonid Tier II Hazard Quotients for Inorganic Mercury at Various Dilutions and with a Best Management Practice Effectiveness Reduction of 10 percent and 28 percent predicted for the 18 Basins***

| Basin | EoP Concentration (µg/L) | HQ EoP | HQ 0.1X$^2$ | HQ 0.01X | HQ for 10% | HQ for 28% |
|---|---|---|---|---|---|---|
| 1 | 0.035 | 17.7 | 1.8 | 0.2 | **1.7** | **1.5** |
| 2 | 0.035 | 17.7 | 1.8 | 0.2 | **1.7** | **1.5** |
| 3 | 0.035 | 17.6 | 1.8 | 0.2 | **1.7** | **1.5** |
| 4 | 0.028 | 13.8 | 1.4 | 0.1 | **1.3** | **1.1** |
| 5 | 0.035 | 17.7 | 1.8 | 0.2 | **1.7** | **1.5** |
| 6 | 0.034 | 17.2 | 1.7 | 0.2 | **1.6** | **1.4** |
| 7 | 0.035 | 17.4 | 1.7 | 0.2 | **1.6** | **1.4** |
| 8 | 0.035 | 17.7 | 1.8 | 0.2 | **1.7** | **1.5** |
| 9 | 0.031 | 15.4 | 1.5 | 0.2 | **1.4** | **1.3** |
| 10 | 0.036 | 17.9 | 1.8 | 0.2 | **1.7** | **1.5** |
| 11 | 0.036 | 17.8 | 1.8 | 0.2 | **1.7** | **1.5** |
| 12 | 0.038 | 18.9 | 1.9 | 0.2 | **1.8** | **1.6** |
| 13 | 0.032 | 15.9 | 1.6 | 0.2 | **1.5** | **1.3** |
| 14 | 0.034 | 16.9 | 1.7 | 0.2 | **1.6** | **1.4** |
| 15 | 0.025 | 12.7 | 1.3 | 0.1 | **1.2** | **1.1** |
| 18 | 0.027 | 13.6 | 1.4 | 0.1 | **1.3** | **1.1** |
| 19 | 0.032 | 15.9 | 1.6 | 0.2 | **1.5** | **1.3** |

***Table 5.21. Salmonid Tier II Hazard Quotients for Inorganic Mercury at Various Dilutions and with a Best Management Practice Effectiveness Reduction of 10 percent and 28 percent predicted for the 18 Basins***

| Basin | EoP Concentration (μg/L) | HQ EoP | HQ 0.1X[2] | HQ 0.01X | HQ for 10% | HQ for 28% |
|---|---|---|---|---|---|---|
| 20 | 0.035 | 17.7 | 1.8 | 0.2 | **1.7** | **1.5** |

Note:
SLEL is the Interim RPA of 2.0 ng/L (0.002 μg/L)
The EoP concentration in based on the geometric mean of the entire data set

***Table 5.22. Summary Statistics for the total Mercury EoP Concentration (μg/L) and HQs for the 0.1X Dilution zone and the 10 percent and 28 percent reduction from the BMPs in the Tier II assessment for salmonids***

| Statistic | [EoP] (μg/L) | 0.1X HQ | HQ for 10% | HQ for 28% |
|---|---|---|---|---|
| ***Geometric Mean*** | 0.03 | 1.7 | 1.6 | 1.4 |
| ***Range (± STD)*** | 0.005 (0.003) | 0.062 (0.17) | 0.59 (0.16) | 0.52 (0.14) |
| ***Median*** | 0.04 | 1.7 | 1.6 | 1.5 |
| ***STD*** | 0.003 | 0.17 | 0.16 | 0.14 |
| ***Margin of error*** | 0.001 | 0.04 | 0.04 | 0.03 |
| ***upper CI*** | 0.034 | 1.7 | 1.6 | 1.4 |
| ***lower CI*** | 0.032 | 1.6 | 1.5 | 1.3 |
| ***Maximum*** | 0.04 | 1.9 | 1.8 | 1.6 |
| ***Minimum*** | 0.03 | 1.3 | 1.2 | 1.1 |

While the purpose of this Section is to account for the efficacy of the BMPs implemented as a result of the permit actions, it should be noted that there is a potential for mercury methylation in the levee ponds and/or other BMPs that are designed to enhance particle settling. In general, the formation of methylmercury is a concern because it is the form of mercury that bioaccumulates in fish (and other biota) and is significantly more toxic than inorganic mercury (Eagles-Smith et al., 2018; Munthe et al., 2007). Methylmercury formation occurs as result of microbial processes that occur under anoxic (no oxygen) conditions and are typically the most elevated in wetland environments due to the presence of abundant nutrients and stagnant water conditions (Hsu-Kim et al., 2013; Windham-Myers et al., 2014). The majority of the drainage basins within the UA discharge to the Clearwater/Snake rivers and do not enter the levee pond system. However, stormwater runoff does enter the levee pond systems, and while they are not designed to treat stormwater in a manner similar to wetlands and stormwater retention ponds, it is feasible that mercury methylation could still be occurring in those waterbodies.

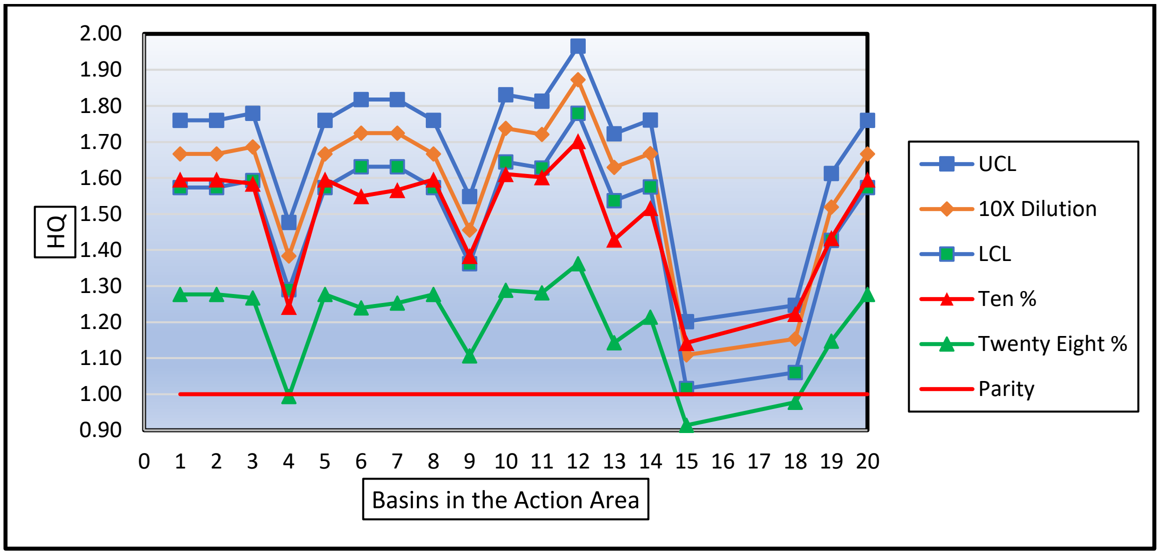


***Figure 5.8. Hazard Quotients, upper (UCL) and lower bounds (LCL) and reductions (10% and 28%) due to BMP Effectiveness for total inorganic mercury in each Basin relative to an HQ of 1.0.***

We used the CORMIX model to estimate dilution of the stormwater discharges in the Action Area. As described in Appendix 1, this modeling was simplified using conservative inputs to predict not only the size of the Action Area but the 0.1X dilution zone centered on an outfall. The stormwater runoff was modeled as a single, continuous discharge located near the confluence of the Clearwater and Snake Rivers. This single discharge is a worst-case assumption and results in a higher single point flow than would be expected in discrete locations in the Action Area. Figure 5.9 depicts the approximate change in HQ values over distance from the point of discharge. The area with the highest HQs is a narrow band, approximately < 5m from the modeled discharge point, with HQs ranging from 16.6 at the EoP to 5.0.

According to Table A.5 (Appendix 1), the output of the CORMIX model the 0.1X dilution zone ranges from 3.5m to 21.5m from the discharge point depending on the port diameter. These distances represent the boundary of the 0.1X dilution zone where the mean HQs are 1.5 and 1.2 depending on the removal efficiency of the BMPs. Beyond this nearfield zone the HQs reach 1.0 over a distance of 13 m to 188m (Figure 5.9). Figure 5.10 presents the graph of the CORMIX output depicting the regions where the concentration reaches 0.004µg/L (HQ = 2.0; see Appendix 1) and 0.002 (HQ=1.0). These edge of the 0.1X dilution zone reached at 20.7m from the point of discharge, however when considering BMP effectiveness, the HQs are less than 2.0 (Figure 5.9)

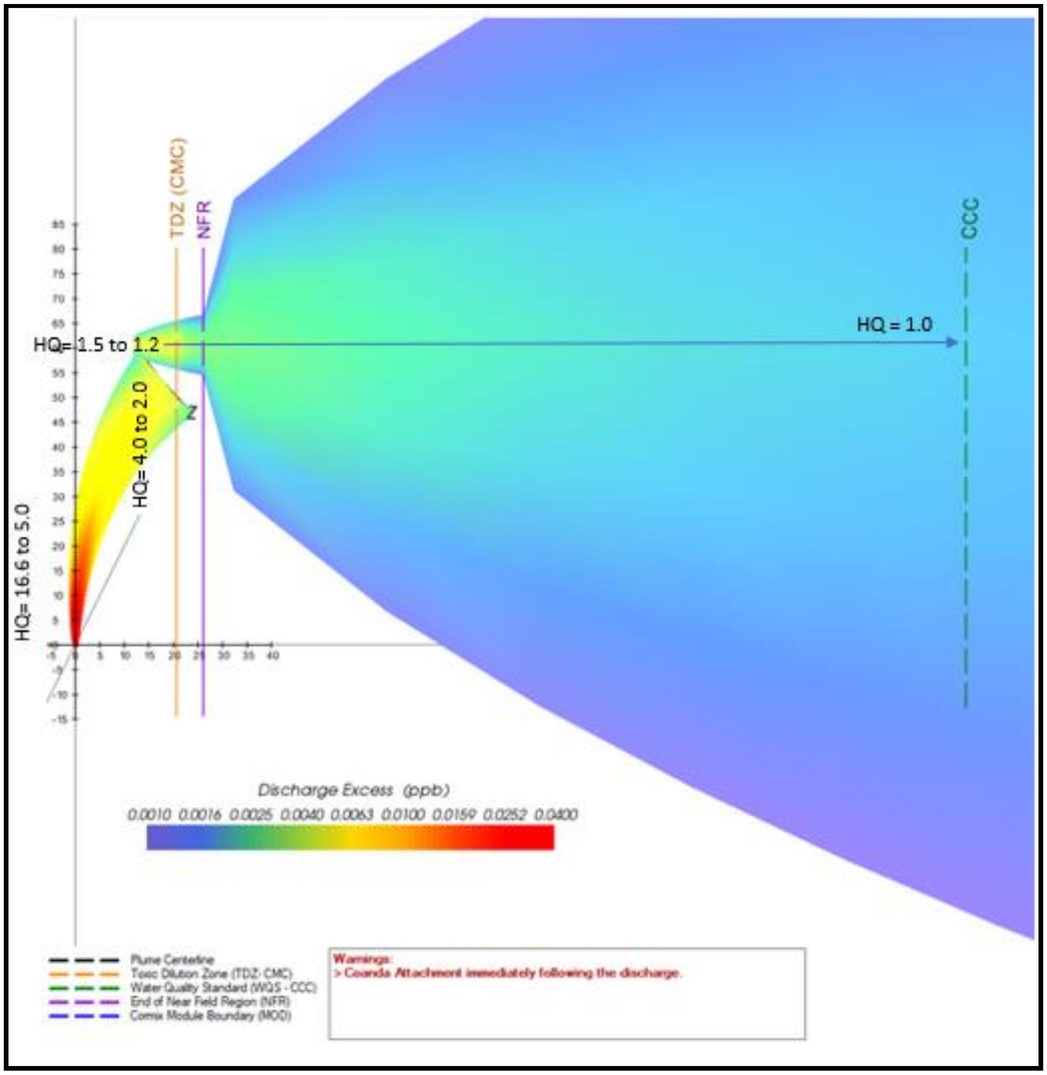


***Figure 5.9. Output of the CORMIX model presenting the range of dilution of total inorganic mercury over distance and the magnitude of the associate mean hazard quotients assuming BMP effectiveness of 10% and 28% removal of particulate-bound mercury.***

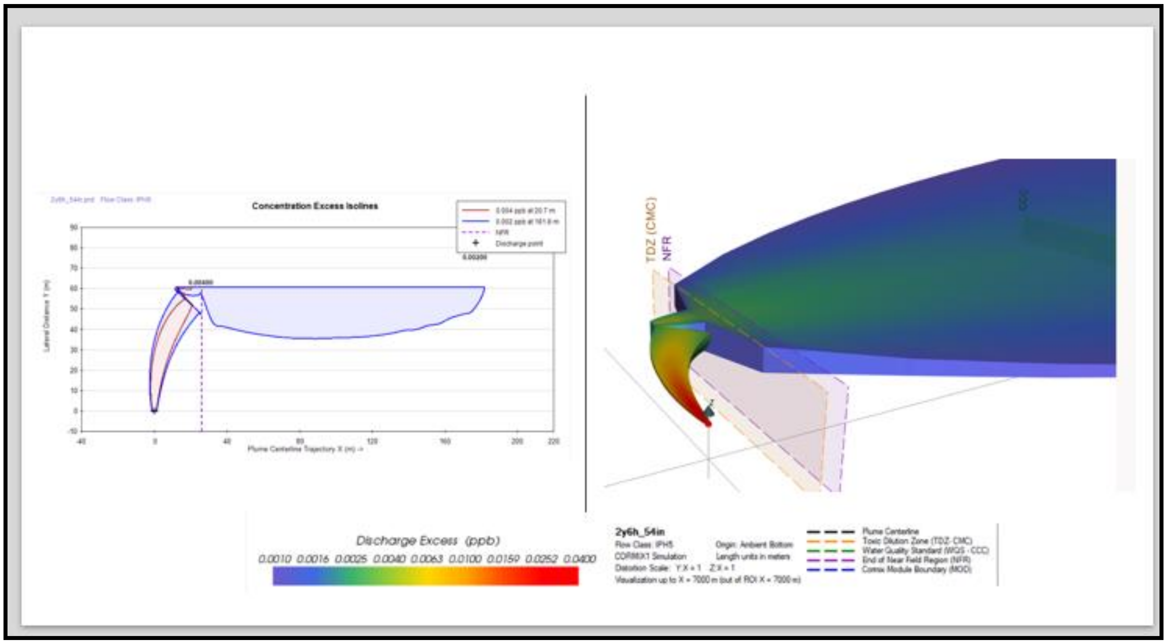


***Figure 5.10. Concentration of total inorganic mercury with distance from the point of discharge.***

### 5.5.3 Prey Species Assessment

We also include a response analysis of the prey categories for each of these species and the bull trout. This Section includes a response analysis of the prey categories for each of the salmonids and bull trout populations present within the Action Area. We evaluated the effects of the stormwater discharges from the MS4 permit area by considering the PCLELs and the GMCV (aluminum) representative of the assemblage of prey items for each species (Table 5.9). The ESA-Salmonid and prey species EPCs were identical as they were calculated for the exposure assessment (Section 5.2); therefore, followed the same screening process.

#### *5.5.3.a Tier I Prey Assessment*

The following presents the results of the Tier I prey assessment for those focal pollutants with a HQ greater than 1.0 at the EoP (no dilution) concentration. Note, a Tier II assessment was conducted for those focal pollutants with a HQ greater than 1.0 in the 0.1X dilution (see Section 5.5.3.b).

Table 5.23 presents the focal pollutants with a HQ greater than 1.0 at the EoP. Fourteen (14) focal pollutants, or 34%, had HQs greater than 1.0 at the EoP (i.e. not considering potential dilution scenarios). These focal pollutants consist of eight metals/metalloids and five PAHs. The EoP HQs range from 1.1 to 14 with the majority exceeding in Basin 13 (downtown). The downtown basin consists of commercial (54%), high density (28%) and low density (13%) with a minimum (5%) open space land use types.

The highest EoP HQ was for total iron (13.8), which was also evaluated under the Tier II prey assessment because the 0.1X dilution HQs exceeded the 1.0 HQ trigger level.

***Table 5.23. Results of the Tier I assessment for Prey based on the geometric mean of the maximum focal pollutant discharge concentrations in each Basin.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| **BASIN #1** | | | | | | |
| Aluminum, dissolved[1] | 252 | 1668 | 0.15 | 0.01 | 0.0001 | 0.00 |
| Copper, dissolved | 5.75 | 2.68 | 2.14 | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | 2.33 | 0.23 | 0.02 | 0.00 |
| Indeno (1,2,3-cd ) pyrene | 0.50 | 0.28 | 1.77 | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.09 | 2.19 | 0.22 | 0.02 | 0.00 | 2.19 |
| Manganese, dissolved | 261 | 98.4 | 2.7 | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.07 | 0.00 |
| Vanadium, dissolved | 45.4 | 25.4 | 1.8 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 38.7 | 36.0 | 1.07 | 0.11 | 0.01 | 0.00 |
| **BASIN #2** | | | | | | |
| Aluminum, dissolved | 252 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Copper, dissolved | 5.75 | 2.68 | 2.14 | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | 2.33 | 0.23 | 0.02 | 0.00 |
| Indeno (1,2,3-cd )pyrene | 0.50 | 0.28 | 1.77 | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.09 | 2.19 | 0.22 | 0.02 | 0.00 | 2.19 |
| Manganese, dissolved | 261 | 98.4 | 2.7 | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.07 | 0.00 |
| Vanadium, dissolved | 45.4 | 25.4 | 1.8 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 38.7 | 36 | 1.07 | 0.11 | 0.01 | 0.00 |
| **BASIN #3** | | | | | | |
| Aluminum, dissolved | 243 | 1668 | 0.14 | 0.01 | 0.001 | 0.00 |
| Benzo(g,h,i)perylene | 0.56 | 0.44 | 1.26 | 0.13 | 0.01 | 0.00 |
| Copper, dissolved | 6.47 | 2.68 | 2.42 | 0.24 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.28 | 2.33 | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.62 | 0.28 | 2.20 | 0.22 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, total | 1.34 | 0.5 | 2.67 | 0.27 | 0.03 | 0.00 |
| Manganese, dissolved | 250 | 98.4 | 2.54 | 0.25 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.067 | 0.07 |
| Vanadium, dissolved | 45.4 | 25.4 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 53.16 | 36 | 1.48 | 0.15 | 0.01 | 0.00 |
| **BASIN #4** | | | | | | |

***Table 5.23. Results of the Tier I assessment for Prey based on the geometric mean of the maximum focal pollutant discharge concentrations in each Basin.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Aluminum, dissolved | 358 | 1668 | 0.21 | 0.02 | 0.002 | 0.00 |
| Benzo(g,h,i)perylene | 0.47 | 0.44 | 1.07 | 0.11 | 0.01 | 0.00 |
| Copper, dissolved | 6.13 | 2.68 | 2.29 | 0.23 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.49 | 0.28 | 1.74 | 0.17 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.51 | 0.28 | 1.83 | 0.18 | 0.02 | 0.00 |
| Iron, total | 4885 | 480 | 10.18 | 1.02 | 0.10 | 0.01 |
| Lead, dissolved | 1.22 | 0.5 | 2.43 | 0.24 | 0.02 | 0.00 |
| Manganese, dissolved | 268 | 98.3 | 2.73 | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.06 | 0.012 | 5.0 | 0.5 | 0.05 | 0.005 |
| Vanadium, dissolved | 33.5 | 25.4 | 1.32 | 0.13 | 0.01 | 0.00 |
| Zinc, dissolved | 48.1 | 36.0 | 1.34 | 0.13 | 0.01 | 0.00 |
| **BASIN #5** | | | | | | |
| Aluminum, dissolved | 252 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Copper, dissolved | 5.75 | 2.68 | 2.15 | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.283 | 2.33 | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.50 | 0.28 | 1.77 | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.79 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | 2.19 | 0.22 | 0.02 | 0.00 |
| Manganese, dissolved | 261.3 | 98.4 | 2.66 | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.07 | 0.07 |
| Vanadium, dissolved | 45.4 | 25.4 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 38.7 | 36 | 1.07 | 0.11 | 0.01 | 0.00 |
| **BASIN #6** | | | | | | |
| Aluminum, dissolved | 220 | 1668 | 0.13 | 0.01 | 0.001 | 0.00 |
| Benzo(b)fluoranthene | 0.95 | 0.68 | 1.40 | 0.14 | 0.01 | 0.00 |
| Benzo(g,h,i)perylene | 0.90 | 0.44 | 2.04 | 0.20 | 0.02 | 0.00 |
| Copper, dissolved | 8.28 | 2.68 | 3.09 | 0.31 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.67 | 0.28 | 2.36 | 0.24 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.92 | 0.28 | 3.30 | 0.33 | 0.03 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.95 | 3.90 | 3.90 | 0.39 | 0.04 | 0.00 |
| Manganese, dissolved | 222 | 98.4 | 2.26 | 0.23 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.067 | 0.007 |
| Vanadium, dissolved | 45 | 25.4 | 1.8 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 88.3 | 2.45 | 2.45 | 0.25 | 0.02 | 0.00 |
| **BASIN #7** | | | | | | |
| Aluminum, dissolved | 227 | 1668 | 0.14 | 0.01 | 0.001 | 0.00 |

***Table 5.23. Results of the Tier I assessment for Prey based on the geometric mean of the maximum focal pollutant discharge concentrations in each Basin.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Benzo(b)fluoranthene | 0.83 | 0.68 | 1.22 | 0.12 | 0.01 | 0.00 |
| Benzo(g,h,i)perylene | 0.79 | 0.44 | 1.79 | 0.18 | 0.02 | 0.00 |
| Copper, dissolved | 7.77 | 2.68 | 2.90 | 0.29 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | 2.33 | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.83 | 0.28 | 2.95 | 0.30 | 0.03 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.76 | 0.5 | 3.53 | 0.35 | 0.04 | 0.00 |
| Manganese, dissolved | 231 | 98.36 | 2.35 | 0.23 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.067 | 0.00 |
| Vanadium, dissolved | 45.4 | 25.41 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 79.4 | 36 | 2.21 | 0.22 | 0.02 | 0.00 |
| **BASIN #8** | | | | | | |
| Aluminum, dissolved | 252 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Copper, dissolved | 5.75 | 2.68 | 2.15 | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.2825 | 2.33 | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.50 | 0.28 | 1.77 | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | 2.19 | 0.22 | 0.02 | 0.00 |
| Manganese, dissolved | 261.3 | 98.36 | 2.66 | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.07 | 0.00 |
| Vanadium, dissolved | 45.4 | 25.41 | 1.78 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 38.7 | 36 | 1.07 | 0.11 | 0.01 | 0.00 |
| **BASIN #9** | | | | | | |
| Aluminum, dissolved | 255 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Copper, dissolved | 5.15 | 2.68 | 1.92 | 0.19 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.57 | 0.2825 | 2.00 | 0.20 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.43 | 0.28 | 1.52 | 0.15 | 0.02 | 0.00 |
| Iron, total | 5669 | 480 | 11.8 | 1.18 | 0.12 | 0.01 |
| Lead, total | 0.96 | 0.5 | 1.93 | 0.19 | 0.02 | 0.00 |
| Manganese, dissolved | 243 | 98.36 | 2.47 | 0.25 | 0.02 | 0.00 |
| Mercury, total | 0.07 | 0.012 | 5.8 | 0.58 | 0.06 | 0.00 |
| Vanadium, dissolved | 39 | 25.41 | 1.53 | 0.15 | 0.02 | 0.00 |
| **BASIN #10** | | | | | | |
| Aluminum, dissolved | 243 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Benzo(g,h,i)perylene | 0.54 | 0.44 | 1.23 | 0.12 | 0.01 | 0.00 |
| Copper, dissolved | 6.70 | 2.68 | 2.50 | 0.25 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.64 | 0.2825 | 2.25 | 0.23 | 0.02 | 0.00 |

***Table 5.23. Results of the Tier I assessment for Prey based on the geometric mean of the maximum focal pollutant discharge concentrations in each Basin.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Indeno(1,2,3-cd) pyrene | 0.60 | 0.28 | 2.16 | 0.22 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.79 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.35 | 0.5 | 2.69 | 0.27 | 0.03 | 0.00 |
| Manganese, dissolved | 250 | 98.36 | 2.54 | 0.25 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.7 | 0.67 | 0.07 | 0.00 |
| Vanadium, dissolved | 45.40 | 25.41 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 61.84 | 36 | 1.72 | 0.17 | 0.02 | 0.00 |
| **BASIN #11** | | | | | | |
| Aluminum, dissolved | 243 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Benzo(g,h,i)perylene | 0.55 | 0.44 | 1.24 | 0.12 | 0.01 | 0.00 |
| Copper, dissolved | 6.63 | 2.68 | 2.47 | 0.25 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.64 | 0.28 | 2.28 | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.61 | 0.28 | 2.17 | 0.22 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.34 | 0.5 | 2.69 | 0.27 | 0.03 | 0.00 |
| Manganese, dissolved | 250 | 98.36 | 2.54 | 0.25 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.70 | 0.67 | 0.067 | 0.00 |
| Vanadium, dissolved | 45.4 | 25.41 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 59 | 36 | 1.64 | 0.16 | 0.02 | 0.00 |
| **BASIN #12** | | | | | | |
| Aluminum, dissolved | 252 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Copper, dissolved | 6.66 | 2.68 | 2.49 | 0.25 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.57 | 0.2825 | 2.00 | 0.20 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.45 | 0.28 | 1.62 | 0.16 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.14 | 0.5 | 2.28 | 0.23 | 0.02 | 0.00 |
| Manganese, dissolved | 261 | 98.36 | 2.66 | 0.27 | 0.03 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.70 | 0.67 | 0.067 | 0.00 |
| Vanadium, dissolved | 45.4 | 25.41 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 73.4 | 36 | 2.04 | 0.20 | 0.02 | 0.00 |
| **BASIN #13** | | | | | | |
| Aluminum, dissolved | 224 | 1668 | 0.13 | 0.01 | 0.001 | 0.00 |
| Benzo(a)pyrene | 1.08 | 0.96 | 1.13 | 0.11 | 0.01 | 0.00 |
| Benzo(b)fluoranthene | 1.24 | 0.68 | 1.82 | 0.18 | 0.02 | 0.00 |
| Benzo(g,h,i)perylene | 1.14 | 0.44 | 2.59 | 0.26 | 0.03 | 0.00 |
| Copper, dissolved | 9.19 | 2.68 | 3.43 | 0.34 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.67 | 0.28 | 2.38 | 0.24 | 0.02 | 0.00 |

***Table 5.23. Results of the Tier I assessment for Prey based on the geometric mean of the maximum focal pollutant discharge concentrations in each Basin.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Indeno(1,2,3-cd) pyrene | 1.14 | 0.28 | 4.07 | 0.41 | 0.04 | 0.00 |
| Iron, total | 6313 | 480 | 13.2 | 1.32 | 0.13 | 0.01 |
| Lead, dissolved | 2.35 | 0.5 | 4.70 | 0.47 | 0.05 | 0.00 |
| Manganese, dissolved | 205 | 98.4 | 2.09 | 0.21 | 0.02 | 0.00 |
| Mercury, total | 0.08 | 0.012 | 6.70 | 0.67 | 0.07 | 0.00 |
| Vanadium, dissolved | 43.29 | 25.4 | 1.70 | 0.17 | 0.02 | 0.00 |
| Zinc, dissolved | 100.86 | 36 | 2.80 | 0.28 | 0.03 | 0.00 |
| **BASIN #14** | | | | | | |
| Aluminum, dissolved | 282 | 1668 | 0.17 | 0.01 | 0.001 | 0.00 |
| Benzo(g,h,i)perylene | 0.49 | 0.44 | 1.11 | 0.11 | 0.01 | 0.00 |
| Copper, dissolved | 6.64 | 2.68 | 2.48 | 0.25 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.57 | 0.2825 | 2.01 | 0.20 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.55 | 0.28 | 1.96 | 0.20 | 0.02 | 0.00 |
| Iron, dissolved | 6051 | 480 | 12.6 | 1.26 | 0.13 | 0.01 |
| Lead, total | 1.28 | 0.5 | 2.57 | 0.26 | 0.03 | 0.00 |
| Manganese, dissolved | 258 | 98.4 | 2.62 | 0.26 | 0.03 | 0.00 |
| Mercury, dissolved | 0.07 | 0.012 | 5.8 | 0.58 | 0.06 | 0.00 |
| Vanadium, dissolved | 41.5 | 25.4 | 1.63 | 0.16 | 0.02 | 0.00 |
| Zinc, dissolved | 63.8 | 36 | 1.77 | 0.18 | 0.02 | 0.00 |
| **BASIN #15** | | | | | | |
| Aluminum, dissolved | 211 | 1668 | 0.13 | 0.01 | 0.001 | 0.00 |
| Benzo(g,h,i)perylene | 0.57 | 0.44 | 1.29 | 0.13 | 0.01 | 0.00 |
| Cadmium, dissolved | 0.22 | 0.15 | 1.48 | 0.15 | 0.01 | 0.00 |
| Copper, dissolved | 6.78 | 2.68 | 2.53 | 0.25 | 0.03 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.54 | 0.28 | 1.92 | 0.19 | 0.02 | 0.00 |
| Iron, total | 6021 | 480 | 12.5 | 1.25 | 0.13 | 0.01 |
| Lead, dissolved | 1.76 | 0.5 | 3.51 | 0.35 | 0.04 | 0.00 |
| Manganese, dissolved | 168 | 98.4 | 1.70 | 0.17 | 0.02 | 0.00 |
| Mercury, dissolved | 0.05 | 0.012 | 4.2 | 0.42 | 0.04 | 0.00 |
| Vanadium, dissolved | 41.29 | 25.4 | 1.63 | 0.16 | 0.02 | 0.00 |
| Zinc, dissolved | 72.74 | 36 | 2.02 | 0.20 | 0.02 | 0.00 |
| **BASIN #16** | | | | | | |
| **BASIN #17** | | | | | | |
| **BASIN #18** | | | | | | |
| Aluminum, dissolved | 163 | 1668 | 0.01 | 0.001 | 0.001 | 0.00 |
| Benzo(g,h,i)perylene | 0.57 | 0.44 | 1.29 | 0.13 | 0.01 | 0.00 |
| Cadmium, dissolved | 0.24 | 0.15 | 1.63 | 0.16 | 0.02 | 0.00 |

***Table 5.23. Results of the Tier I assessment for Prey based on the geometric mean of the maximum focal pollutant discharge concentrations in each Basin.***

| Parameter | Estimated Concentration (µg/L) | Selected Risk Value (µg/L) | HQ EoP | HQ 0.1X | HQ0.01X | HQ0.001X |
|---|---|---|---|---|---|---|
| Copper, dissolved | 6.86 | 2.68 | 2.56 | 0.26 | 0.03 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.54 | 0.28 | 1.91 | 0.19 | 0.02 | 0.00 |
| Iron, dissolved | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, total | 1.81 | 0.5 | 3.63 | 0.36 | 0.04 | 0.00 |
| Manganese, dissolved | 151 | 98.4 | 1.53 | 0.15 | 0.02 | 0.00 |
| Mercury, dissolved | 0.06 | 0.012 | 5.0 | 0.5 | 0.05 | 0.005 |
| Vanadium, dissolved | 45.4 | 25.4 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 76.8 | 36 | 2.13 | 0.21 | 0.02 | 0.00 |
| **BASIN #19** | | | | | | |
| Aluminum, dissolved | 207 | 1668 | 0.12 | 0.01 | 0.001 | 0.00 |
| Benzo(b)fluoranthene | 0.91 | 0.68 | 1.33 | 0.13 | 0.01 | 0.00 |
| Benzo(g,h,i)perylene | 0.87 | 0.44 | 1.99 | 0.20 | 0.02 | 0.00 |
| Cadmium, dissolved | 0.16 | 0.15 | 1.06 | 0.11 | 0.01 | 0.00 |
| Copper, dissolved | 7.69 | 2.68 | 2.87 | 0.29 | 0.03 | 0.00 |
| Dibenzo(a,h)anthracene | 0.60 | 0.28 | 2.12 | 0.21 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.88 | 0.28 | 3.16 | 0.32 | 0.03 | 0.00 |
| Iron, dissolved | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.94 | 0.50 | 3.88 | 0.39 | 0.04 | 0.00 |
| Manganese, dissolved | 206 | 98.4 | 2.09 | 0.21 | 0.02 | 0.00 |
| Mercury, dissolved | 0.08 | 0.012 | 6.70 | 0.67 | 0.07 | 0.00 |
| Vanadium, dissolved | 45.4 | 25.4 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 72.4 | 36 | 2.01 | 0.20 | 0.02 | 0.00 |
| **BASIN #20** | | | | | | |
| Aluminum, dissolved | 251 | 1668 | 0.15 | 0.01 | 0.001 | 0.00 |
| Copper, dissolved | 5.75 | 2.68 | 2.15 | 0.21 | 0.02 | 0.00 |
| Dibenzo(a,h)anthracene | 0.66 | 0.28 | 2.33 | 0.23 | 0.02 | 0.00 |
| Indeno(1,2,3-cd) pyrene | 0.50 | 0.28 | 1.77 | 0.18 | 0.02 | 0.00 |
| Iron, total | 6620 | 480 | 13.8 | 1.38 | 0.14 | 0.01 |
| Lead, dissolved | 1.09 | 0.5 | 2.19 | 0.22 | 0.02 | 0.00 |
| Manganese, dissolved | 261 | 98.4 | 2.66 | 0.27 | 0.03 | 0.00 |
| Mercury, dissolved | 0.08 | 0.012 | 6.70 | 0.67 | 0.067 | 0.00 |
| Vanadium, dissolved | 45.40 | 25.4 | 1.79 | 0.18 | 0.02 | 0.00 |
| Zinc, dissolved | 38.66 | 36 | 1.07 | 0.11 | 0.01 | 0.00 |

### *5.5.3.b Tier II Prey Species Assessment*

A Tier II analysis was conducted for total iron because the predicted EPCs exceeded the PCLEL obtained through the conservative screening or Tier I analysis (Table 5.23). As described in the Tier I analysis, if the predicted EPC (HQ>1.0) at the 0.1X dilution then a Tier II analysis will be conducted (Section 5.3.6.a). This analysis is intended to determine whether predicted EPCs (at the nearfield dilution of 0.1X) impacts the relationships between ESA-listed fish and their prey.

To calculate the reasonable, worst-case EPCs for total iron, EPA slightly modified the methodology described in Section 5.2. EPA kept the aggregated datasets based on land use as described above, however, instead of analyzing the maximum values from each report, EPA considered all data within a particular land type dataset. Any non-detects were substituted with the maximum reported value. EPA calculated the geometric mean of this data to estimate total iron in stormwater runoff across the different land uses. Section 5.5.2.a provides an overview of the calculation. Taking the geometric mean of all data within a land use classification, instead of only the maximum data points, offers a less conservative and more realistic analysis of the total iron concentrations in MS4 discharges within the Action Area. Table 5.24 presents the total iron concentrations used in both the Tier I and Tier II assessments. The revised estimated total iron concentrations for the Tier II assessment resulted in an average reduction in concentration of 91.5 percent.

***Table 5.24. Comparison of the estimated Tier I and Tier II total iron EoP concentrations in stormwater runoff from each basin within the Action Area.***

| **Basin** | **Estimated EPCs at EoP (µg/L)** | |
|---|---|---|
| | **Tier I** | **Tier II** |
| 1-5,<br>7-12,<br>15,<br>18-20 | 6620 | 560 |
| 6 | 4886 | 413 |
| 13 | 6313 | 534 |
| 14 | 6051 | 512 |
| 15 | 6021 | 509 |
| *Summary Statistics* | | |
| Min | 4886 | 413 |
| Max | 6620 | 560 |
| Mean | 6389 | 540 |
| Range | 1734 | 147 |
| STD | 468 | 40 |
| Upper CI | 6605 | 559 |
| Lower CI | 6173 | 522 |
| Percent Change | 91.5% | |
| *Note: No predicted stormwater runoff from Basins 16 and 17* | | |

As described in Section 1125.3.6.b, the ECOTOX database queries were sorted for categories of potential prey species from highest to lowest effect concentrations for both acute and chronic toxicity test data. The lowest acute effect concentration was adjusted as necessary (i.e. from $LC_{50}$ to $LC_{Low}$), and then compared to estimated EPCs. The likelihood of an adverse effect was based on the percent of the species mean acute values (SMAV) or species mean chronic values (SMCV) less than the predicted EPCs. The lowest SMAV or SMCV if available or lowest acute or chronic effect level was identified as the PCLEL for each prey category.

These acute and chronic PCLELs were compared to the estimated EPCs at the 0.1X dilution, which is an order of magnitude less than what is presented in Table 5.24, to determine if the PCLELs were elevated relative to the iron EPCs, which would indicate a potential effect to ESA-salmonid species prey. The acute and chronic toxicity of total iron in freshwater was evaluated for fish and crustaceans and aquatic invertebrates with PCLELs of 520 µg/L, 480 µg/L and 7,863 µg/L, respectively (Table 5.25). The acute and chronic PCLELs for fish and aquatic insects were higher than the estimated EoP concentrations.

***Table 5.25. Range of adverse chronic effect assessment for total iron concentrations (µg/L) for categories of prey species of the ESA-listed salmonid species.***

| Prey Category | N Species | PCMCV | Range | Prey Category Lowest Toxicity Value (PCLEL) | | |
|---|---|---|---|---|---|---|
| | | | | PCLEL | Species | Reference |
| Aquatic Insects | 2 | 12484 | 7863 – 19818 | 7863 | *Hexagenia limbata* | (Cadmus et al. 2018) |
| Fish | 6 | 2624 | 520 – 9237 | 520 | *Pimephales promelas* | (Smith et al. 1973) |
| Crustaceans | 4 | 1587 | 480 – 5200 | 480 | *Ceriodaphnia dubia* | ASTM Spec. Tech. Publ.6:551-556 |
| Aquatic Invertebrates | No Data | | | | | |
| Mollusc | No Data | | | | | |

Using recent biodiversity research on changes in species richness effects on ecological communities, a decline of more than 20% in species richness of the prey of ESA-listed species is defined in this BE as a meaningful portion of the listed species diet, warranting an adverse effect determination based on an indirect effect on ESA listed species (Hooper et al. 2012; Vaughn, 2010). A 20% change in species richness is consistent with other lines of evidence in water quality criteria derivation and ecological risk assessment, where a 20% change in a parameter is used as a threshold for adverse effects (Suter et. al. 2000). When comparing the highest EPC (560 µg/L) to the SMAVs and SMCVs reported for total iron (19), only 10.5% of the values were below this EPC. Therefore, the total iron EPC is not expected to result in a reduction of more than 20% of the prey population in the Action Area.

### 5.5.4 Summary

Results of the Tier II salmonid assessment indicate that the HQs in the Action Area are comparable to HQs calculated for background mercury measured in large rivers in Idaho. While the HQs exceed 1.0, they are not significantly elevated (less than 2.0), which does not definitively lead to unequivocal adverse effects, but must be considered along with: 1) the spatial extent of the 0.1X dilution, 2) the quality of the habitat within this dilution zone, and 3) the concomitant use of this habitat by ESA-listed salmonids.

The loading of total inorganic mercury was predicted to be 0.003 lbs and 0.01 lbs over the Action Area for the two storm events. The potential impact of this amount of total mercury would not be measurable. According to the flow data reported by the USACE the levee pond discharges are less than 0.01 of the flow of the Clearwater River, we would assume that this loading also constitutes a similar percent of the background mercury which ranges from 0.8 to 1.9 ng/L.

The loading calculations also do not estimate pollutant reductions as a result of current onsite BMPs nor estimate the potential reduction in pollutant loadings as result of implementing future BMPs as required by the Permits. Therefore, collectively, these uncertainties result in a more conservative evaluation of pollutant loadings from the MS4 described within the BE to the receiving waterbodies within the Action Area.

## 5.6 TEMPERATURE

Water temperature can affect the behavior and growth of aquatic organisms and therefore reduce survival. Rivers and streams in the Pacific Northwest naturally warm in the summer due to increased solar radiation and warm air temperature. Human changes to the landscape have magnified the degree of river warming, which adversely affects salmonids and reduces the number of river segments that are thermally suitable for salmonids. Human activities can increase the heat load into the river by reducing the river’s flow and thus its capacity to absorb heat, and by eliminating or reducing the amount of groundwater flow which moderates temperatures and provides cold water refuge. USEPA (2003b) has presented specific ways in which human development has caused excess warming of rivers. These are summarized as follows:

- Removal of streamside vegetation reduces the amount of shade that blocks solar radiation and increases solar heating of streams. Examples of human activities that reduce shade include forest harvesting, agricultural land clearing, livestock grazing, and urban development.
- Removal of streamside vegetation also reduces bank stability, thereby causing bank erosion and increased sediment loading into the stream. Bank erosion and increased sedimentation results in wider and shallower streams, which increases the stream’s heat load by increasing the surface area subject to solar radiation and heat exchange with the air.
- Water withdrawals from rivers for purposes such as agricultural irrigation and urban/municipal and industrial use result in less river volume. Some withdrawn

water is returned to the river as treated wastewater or irrigation return flow, but often at warmer temperature than it was withdrawn. The temperature of rivers with shallower depth equilibrates faster to surrounding air temperature, which leads to higher maximum water temperatures in the summer when lower flows lead to shallower depths.

- Water discharges from industrial facilities, wastewater treatment facilities and irrigation return flows can add heat to rivers.
- Channeling, straightening, or diking rivers for flood control and urban and agricultural land development may reduce some components of cool groundwater flow into a river that moderates summertime river temperatures. These human actions can reduce two forms of groundwater flow. One form is groundwater that is created during over-bank flooding and is slowly returned to the main river channel to cool the water in the summer. A second form is water that is exchanged between the river and the riverbed (i.e. hyporheic flow). Hyporheic flow is plentiful in fully functioning alluvial rivers systems. Groundwater that flows into rivers from regional aquifer systems provides most of the cool groundwater to rivers and is unaffected by most stream channel modifications.
- Removal of upland vegetation and the creation of impervious surfaces associated with urban development increases storm runoff and reduces the amount of groundwater that is stored in the watershed and slowly filters back to the stream in the summer to cool water temperatures.
- Dams and their reservoirs can affect thermal patterns in several ways. In some cases, they can increase maximum temperatures by holding waters in reservoirs to warm, especially in shallow areas near shore. In other cases, reservoirs, due to their increased volume of water, are more resistant to temperature change and thus can be cooler than unimpounded rivers. The greater resistance of reservoirs to temperature changes results in reduced diurnal temperature variation and delayed changes in river temperature. For example, dams can delay the natural cooling that takes place in the late summer-early fall, thereby harming late summer-fall migration runs. Reservoirs also inundate alluvial river segments, thereby diminishing the groundwater exchange between the river and the riverbed (i.e., hyporheic flow) that cools the river and provides coldwater refugia during the summer. Further, dams can significantly reduce the river flow velocity, thereby causing juvenile migrants to be exposed to high temperatures for a much longer time than they would under a natural flow regime.

It should also be noted that some human development could create water temperatures colder than an unaltered river. The most significant example of this occurs when cold water is released from the bottom of a thermally stratified reservoir behind a dam.

Water temperature can change chemical properties of the water. The discussion below explains how pH, DO, and ammonia can all be affected by changes in water temperature:

- <u>pH:</u> Temperature does not directly affect pH; however, they both vary on a seasonal and diurnal basis. Algae in the stream give off $CO_2$ at night when they respire. $CO_2$ disassociates to form carbonic acid, thus lowering the pH to potentially stressful levels. This pH stress is greatest at night, when temperature is at its coolest and thus least stressful. However, respiration is seasonally greatest during the summer, when algal populations are greatest, and thus coincides with seasonal high temperatures.

- DO: The saturation concentration of DO in water decreases with increasing temperature: fresh water at a temperature of 0º C has an oxygen solubility of 14.6 mg/L while that at 30º C has a solubility of 7.6 mg/L (APHA, 1998).
- Ammonia: USEPA (1999d) updated their Ambient Water Quality Criteria for Ammonia. They reviewed the literature and found that, following normalization for pH, the freshwater acute toxicity data concerning temperature dependence show neither large effects nor any clear consistency among or within species or studies. Therefore, the acute ammonia criterion does not change with temperature. However, the acute ammonia criterion is lower when salmonids are present. USEPA (1999d) also looked at the chronic toxicity of ammonia to fish and concluded that available data suggest minimal dependence of ammonia toxicity on temperature. They stated that although limited available chronic data suggest $LC_{20}$s might be lower at low temperatures, the effect is small and uncertain (USEPA, 1999d). The chronic ammonia criterion does, however, depend on temperature, pH, and whether early life stages are present. The chronic criterion increases with decreasing temperature and increases with increasing pH.

### 5.6.1 Temperature Impacts on Salmonid Habitat

Because temperature conditions are so critical to the health of salmonid populations at all life history phases, it is a well-studied parameter in the Pacific Northwest. The *EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards* (USEPA, 2003b) specifically addresses water temperature values that are protective of salmonids at various life history stages. These values were developed from a synthesis of an extensive body of literature by a technical workgroup (USEPA, 2001), which produced technical summaries on the thermal effects on physiology and behavior, thermal influences on distribution, spatial and temporal variation in stream temperature patterns, and the interactions between multiple stressors affecting salmonids. This effort resulted in recommended temperature criteria considered protective of various salmonid species at important life history phases. The criteria relevant to species of this BE are listed in Table 5.26.

***Table 5.26. EPA Region 10 Recommended Temperature Criteria to be applied to water bodies based on salmonid use categories (USEPA 2003b).***

| Salmonid Uses | Criteria |
|---|---|
| **Summer Maximum Conditions** | |
| Bull Trout Juvenile Rearing | 12˚C 7DADM[1] |
| Salmon/Trout[2] "Core3" Juvenile Rearing (*includes salmon adult holding prior to spawning, and adult and sub-adult bull trout foraging and migration)* | 16˚C 7DADM |
| Salmon/Trout Migration plus Non-Core Juvenile Rearing | 18˚C 7DADM |
| Salmon/Trout Migration | 20˚C 7DADM |
| **General Conditions** | |
| Bull Trout Spawning | 9˚C 7DADM |
| Salmon/Trout Spawning, Egg Incubation, and Fry Emergence | 13˚C 7DADM |
| Steelhead Smoltification | 14˚C 7DADM |

1. 7DADM = 7-day average daily maximum. Calculated by averaging daily maxima over 7-day periods to form a rolling 7DADM.
2. For this BE Salmon refers to Chinook and Sockeye and Trout refers to Steelhead
3. 'Core' refers to areas of high to moderate use

Based on the information in the Region 10 temperature guidance (USEPA, 2003b), shown above, and the timing of fish use of the Action Area described in Section 3, the following temperature benchmarks are applicable to protect the listed salmonids (bull trout, Snake River sockeye salmon, Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, and Snake River steelhead) in the Action Area (Table 5.27).

***Table 5.27. Applicable water temperature benchmarks based on USEPA 2003b for salmonids with likely presence in the Action Area as reviewed in Chapter 3.***

| Species | Life History phase | Temperature | Duration |
|---|---|---|---|
| Salmon/steelhead | smoltification | 14 ºC 7DADM | Mar - May |
| Salmon/steelhead | juvenile rearing | 18 ºC 7DADM | Jun-winter |
| Salmon/steelhead | adult migration | 20 ºC 7DADM | Jul - Aug |
| Bull trout | Adult/sub-adult foraging/migration | 16 ºC 7DADM | Nov - May |

***Note:*** *as previously discussed, fall chinook juveniles with reservoir-type life history use Action Area for protracted period which overlaps with adult migration.*

### 5.6.2 Current Water Quality Standards

The current Idaho water quality standards for the Snake River is 22°C as a daily maximum and a maximum daily average of 19°C, based on the goal of protection of aquatic life. If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then wastewater must not raise the receiving water temperatures by more than three tenths (0.3) °C.

The current Washington water quality standard for the Snake River from its mouth to the Washington – Idaho – Oregon border (River Mile 176.1) is 20°C as a daily maximum temperature. When natural conditions exceed a daily maximum of 20.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C

### 5.6.3 Analysis of Thermal Inputs from Stormwater

There are no water temperature data available that are specific to the City/LCSC and ITD#2 MS4 discharges to be regulated under this Action. The closest study found that can be used as a relative surrogate is a study of the USACE levee ponds conducted in 2005 (USACE, 2005). This study provides temperature measurements used to compare upstream-downstream temperature changes in the river relative to the ponds. The following paragraph is the study summary from USACE 2005:

> *"Temperature measuring devices were installed at four pump stations and nine in-river locations in late July 2005 and recorded hourly data through August. Sensor accuracy reported by the manufacturer, and verified by the Corps, was ±0.2  C. Average downstream temperature changes computed for the Clearwater River monitoring stations that bracketed each pond did not exceed 0.1 °C, despite the fact that East Pond and West Pond mean temperatures were 7 to 10 °C higher than Clearwater River water temperatures. The mean temperature change determined for the 4.7-mi reach between the two boundary stations, as well as the mean absolute difference between replicate sensors, was also 0.1 °C. Diel temperature fluctuations in the river averaged about 2 °C, but did reach 3 °C on during some days, compared to 4-5 °C in two of the ponds. The overall thermal effect of pond discharges on the Clearwater River were immeasurable due in large part to the fact that the discharge from all four ponds combined was only about 0.2% of river flow during August 2005."*

Based on the shallow depth of these ponds and exposure to sunlight which results in elevated summer temperatures, the measured temperatures of some of the ponds exceeded the temperature benchmarks outlined in Table 5.27, above. However, it is unlikely that general stormwater runoff from the City/LCSC and ITD #2 MS4s, which would not normally accumulate in ponds, would reach these temperatures. In addition, temperature contributions from direct stormwater discharges would be minimal compared to the 49,800 cfs mean annual flow of the river the stormwater would be entering, thereby resulting in minimal temperature changes to the river.

## 5.7 EFFECT ON CRITICAL HABITAT

In the Action Area, the following species have designated critical habitat: sockeye salmon, steelhead, bull trout, spring/summer Chinook salmon, and fall Chinook salmon. Possible consequences to critical habitat within the Action Area was assessed using the critical habitat PBFs and the results from the water quality assessment. The PBFs for salmonids and bull trout are discussed in Section 3 and restated below. As stated previously in Section 5.3, the most relevant to this action are those PBFs that may be affected by water quality. Effects determinations on critical habitat and their PBFs was considered to be adverse if the water quality within the habitat was estimated to be toxic to fish or other aquatic organisms.

### 5.7.1 Snake River Salmonids

The PBFs for salmon and steelhead critical habitats are listed and the possible effects of the action on them are described below:

1) *Freshwater spawning sites with water quality conditions and substrate supporting spawning, incubation and larval development.*

   The action will have no effect on this PBF.

2) *Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions supporting juvenile growth and mobility; water quality and forage supporting juvenile development, and natural cover.*

   The assessment of water quality parameters and toxicants conducted in this document above determined that water quality would not be impacted in a way that would affect physical habitat conditions supporting juvenile growth and mobility or rearing sites and forage supporting juvenile development this PBF.

3) *Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover.*

   The most relevant of the critical habitat PBFs that could be affected by the Agency's action is water quality and specifically water temperature to protect adult Sockeye migration and spawning. Migration corridor temperatures will be insignificantly affected by the Agency's action and EPA does not believe the action will significantly adversely affect Sockeye critical habitat for the reasons described in Section 5.6. Natural cover will not be affected by this action.

### 5.7.2 Columbia River Bull Trout

The possible effects of the action on the PBFs for bull trout critical habitat are described below:

1) *Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.*

The action will have no effect on springs, seeps, groundwater or subsurface water connectivity because the action is not modifying the flow of these waters.

2) *Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.*

Of the potential impediments to migration, water quality was the only impediment that may be created by the action. Possible effects to water quality were assessed as described above and it was determined that the resulting water quality from the action would not negatively impact fish or their prey (direct or indirect effects). No physical or biological impediments will be caused by the action.

3) *An abundance of food, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.*

Poor water quality could affect the abundance of food. The possible effect of the action on water quality and its effects on the abundance of food (indirect effects) was found not likely in the assessment above in this document.

4) *Complex shorelines with features such as large wood, side channels, pools, undercut banks, and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure*

Complex shorelines with its features would not be affected by this action, as it is a storm water discharge permit.

5) *Water temperatures ranging from 2 to 15°C (36 to 59°F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.*

The possibility of the action causing exceedances of this temperature range was assessed in the document above and it was determined that there would be no detrimental effect, see Section 5.6.

6) *In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.*

As presented in the document above, bull trout do not spawn in the Action Area, therefore, this PBF will not be affected.

7) *A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departures from a natural hydrograph.*

Flow from these outfalls are minimal compared to the receiving waters and will not significantly change the natural hydrograph and therefore not affect this PBF.

8) *Sufficient water quality and quantity to sustain normal reproduction, growth, and survival.*

   Water quality was assessed for direct and indirect effects on fish, and on their forage. Significant effects on neither were found in the assessment.

9) *Low occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species.*

   The action will have no effect on the occurrence of nonnative predatory, interbreeding, of competing species.

## 5.8 UNCERTAINTIES ASSOCIATED WITH THE ANALYSIS

By design, risk assessments and, in the case of this BE, toxicity assessments are conservative in the face of uncertainty. In this context, “conservative” means efforts were made to minimize the chances of underestimating exposure, effects, or hazard. The uncertainty analysis portion of each chemical’s toxicity assessment is intended to illustrate the degree of confidence in the conclusions of the assessment.

Uncertainty in a risk assessment has four components:

1. Variation (e.g. a fish is exposed to a range of chemical concentrations in water, not to a constant concentration of a chemical);
2. Model uncertainty (e.g. use of a single species or several target ecological receptors to represent the sensitivity of a listed species to a chemical introduces uncertainty because of the considerable amount of interspecies variability in sensitivity to a chemical);
3. Decision rule uncertainty (e.g. use of a dichotomous decision framework to determine chemical effects (i.e. NLAA vs. LAA) instead of calculating the probability of an adverse effect at the expected environmental concentrations); and
4. True unknowns (e.g. the toxic effects of a chemical in water on bull trout survival, growth, and reproduction that has never been studied, and is unknown).

Examples of conservatism include assumptions that chemical contaminant concentrations are 100% bioavailable, and assumptions that the most reliable evaluation of chemical toxicity to listed species in the absence of empirical listed species toxicity data generally comes from basing the assessment only on the most closely taxonomically related species to a particular listed species that had available and high-quality empirical toxicity data.

| ***Table 5.28. Specific point of uncertainty and their impact on the outcome of the Hazard Assessment*** | | | | | |
|---|---|---|---|---|---|
| **Hazard Assessment Step** | **Type** | **Description of Uncertainty** | **Overestimate** | **Underestimate** | **Over or Under-estimate** |
| Available Discharge Data | True Unknown | Lewiston Levee Reports reported no detected mercury concentrations; the MRL and MDL were higher than the 2 ng THg/L Interim RPA; therefore, used the MRL as the discharge concentration which is higher than the MDL. | X | | |
| | | Use of Western Washington Report as surrogate data | X | | |
| | | Use of Puget Sound Toxics Report as surrogate discharge data | | X | |
| EoP Concentrations and Loading | Modeling Uncertainty | Assumption about land use within each drainage Basin | | | X |
| | | Use of maximum discharge concentrations to predict the EoP concentrations | X | | |
| Dilution Modeling | Modeling Uncertainty | Modeled all stormwater runoff discharges as one continuous discharge in the Action Area | X | | |
| | | Use of CORMIX to estimate the size of the discharge plume and the THg concentration over distance from discharge point. | | | X |
| | | Applied the area of the discharge plume from a single-continuous discharge to each individual outfall location. | X | | |
| Exposure | True Unknown | No travel time data available for juvenile sockeye salmon. EPA used the data for sub-yearling Fall Chinook as surrogate data. | | | X |
| | | Stormwater discharges are episodic and Exposure Analysis evaluated a continuous discharge | X | | |
| | | Lack of stormwater data for total aluminum impacts exposure and response analysis for salmonids and their prey | | X | |
| Toxicity Assessment | True Unknown | Lack of prey species toxicity data | | X | |
| | | Use of surrogate species data for ESA-listed salmonids | | | X |
| | Variation Unknown | Mixture toxicity of multiple FOCs with different mechanisms of action. | | | X |
| | Modeling Uncertainty | Use of acute to chronic ratios to adjust an acute endpoint (survival) to a chronic endpoint (growth, reproduction) | | | X |
| | | Use of lowest effect (NOEC) levels to develop SLELs. | X | | |
| | | Utilized the Interim RPA for THg established for the protection of Trophic level 4 fish to assess effects to Trophic level 2 and 3 species. | X | | |

### 5.8.1 Prediction of Pollutant Loadings and Exposure Point Concentrations

#### *5.8.1.a Stormwater Discharge Data*

The availability of empirical data for the Action Area was limited to sampling events conducted by the USACE in 2004 and 2005 (Section 5.1.1). EPA attempted to locate other empirical data for the Action Area including biotic and abiotic data, but none was available. The USACE data was collected over 15 years ago before the completion of ESA consultations on some chemicals considered in this BE. Mercury presented a challenge, as the Interim RPA for mercury was issued in 2014 and the MRL used in the USACE data was above this RPA. Therefore, even though mercury was not detected in the discharge from the ponds, EPA included it because mercury may be present at levels above the RPA; this is a true unknown.

As with mercury, EPA used the MRL as the concentration for other stormwater pollutants, which overestimates the EPCs and presents a significant source of uncertainty in species exposure and magnitude of the HQ. The concentration of the pollutants is somewhere between the MDL and the MRL.

The USACE measured over 200 chemicals in their sampling events, and EPA focused on toxic chemicals that were detected. It wasn’t possible to develop the SLELs and PCLELs to compare to the MRLs. Instead, EPA relied on more recent robust stormwater data sets for Washington State to characterize the Lewiston stormwater discharges. This introduces uncertainty in the chemical composition and concentration of pollutants in the discharge, since the data were collected from large urban landscape and compared to the Lewiston MS4 area.

#### *5.8.1.b End-of-Pipe Pollutant Loading and Concentrations*

As discussed in Sections 5.2.3 and 5.2.4, EPA relied on the Lewiston Levee Reports, the Puget Sound Toxics Report, and the Western Washington Report as the sources of EoP concentrations and pollutant loadings. There are key differences between these studies, which are discussed in detail in Section 5.1. Due to there being only two grab samples with no direct connection to a specific land use, the data reflected in the Lewiston Levee Reports is not representative of land use within the Lewiston MS4 area nor is it representative of an entire storm event. Due to sample collection methods (e.g. grab versus flow-weighted composite samples) and/or sample locations (e.g. receiving waterbody sample versus end-of-pipe sample), the results from the Puget Sound Toxics Report underestimate the observed pollutant concentrations but provide valuable data for open space land uses. The Western Washington Report contains data from significantly larger Phase I MS4 communities and it is likely that it overestimates pollutant concentrations and loadings from smaller Phase II MS4 communities like those in the Lewiston area.

Furthermore, the monitored land uses and definitions of similar land uses from each of the three reports are different. EPA aggregated data based on seemingly similar land uses, however, there is uncertainty as to how similar each land use is. Additionally, within each dataset non-detects were reported. A value of non-detect does not mean a concentration of zero, rather, the true concentration is between the MDL and the MRL. Therefore, EPA made the conservative assumption to replace each non-detect with the reporting limit reflecting the higher of the two and results in an overestimation of the discharge concentrations. Table 5.29 summarizes the differences across the three studies used to estimate EoP concentrations for each focal pollutant.

***Table 5.29. Summary of differences between stormwater pollutant data sources.***

| Source | Representative of Locality? | Representative of a Storm Event? | Representative of a Land Use | Representative of a MS4 discharge? |
|---|---|---|---|---|
| Lewiston Levee Reports | Local | Snapshot of Event | Not representative of specific land uses | Surface waters of levee ponds prior to discharge |
| Puget Sound Toxics Report | Regional – out of state | Snapshot of Event | Underestimates | Surface waters |
| Western Washington Report | Regional – out of state | Representative | Representative | Large MS4s |

Furthermore, as discussed in Sections 5.2.1 and 5.2.2, EPA did not have enough information to evaluate pollutant concentrations on an outfall-specific basis described within this BE. As a result, EPA evaluated the pollutant concentrations for 18 of the 20 basins based on the known land uses within the Lewiston MS4 boundaries.

Loading was aggregated based on discharge location. This results in a loading estimate that is reflective of a discharge from a single area of the MS4 rather than the reality of that runoff likely being discharged from multiple outfall locations. Therefore, the estimated loading values should be treated as total loadings from the MS4 and not assumed that each outfall will discharge a pollutant at that level.

EPA modeled stormwater runoff using the curve number method (Section 5.2), which required assumptions to be made regarding the frequency and duration of a storm event. EPA evaluated runoff from two storm events: the two-year six-hour and two-year twenty-four-hour storm events. While these storm events are common to Idaho, this analysis does not consider more extreme storm events, nor shorter duration storms. Furthermore, EPA used the maximum concentrations (as found in each Report) to develop end-of-pipe receiving water concentrations and loadings for a tier I analysis. Although, it is possible for an MS4 to discharge such high concentrations, it will more frequently discharge lower concentrations and loadings.

Lastly, the loading calculations do not take into account expected pollutant reductions as a result of the comprehensive SWMPs and associated BMPs that are to be implemented within the MS4 area as a result of the Action. Sections 2.2.4 and 5.5.2.d includes tables that summarize some of the BMPs currently in place and/or that will be implemented within the Lewiston MS4 area as a result of the Action..

Collectively, these uncertainties result in a more conservative evaluation of pollutant concentrations and loadings from the MS4sdescribed within the BE to the receiving waterbodies within the Action Area.

#### *5.8.1.c CORMIX Modeling*

There are a number of uncertainties associated with using CORMIX to model a discharge from the Lewiston MS4 (Appendix 1). Most obvious is that CORMIX was not developed with stormwater discharge specifically in mind. Stormwater discharged through an MS4 often behaves differently than a continuous discharge from a wastewater treatment plant or industrial facility. The volume and velocity of stormwater discharges vary throughout a storm event and vary between storm events of different sizes and intensities. In the CORMIX model, EPA assumed a continuous and consistent discharge of stormwater for the duration of the storm event, but in reality these discharges are not steady state flow events and will fluctuate throughout the hydrograph. Furthermore, EPA modeled the concentration of total mercury in the discharge as a continuous steady state concentration. In addition to flow, the concentration of any pollutant found in a stormwater discharge will vary throughout the hydrograph. Buildup of pollutants can occur during extended antecedent dry periods leading to a “first flush” scenario where large pollutant loads are released during the first storm event followed by smaller loads in subsequent storm events.

EPA’s used only one set of ambient conditions in every CORMIX scenario. The ambient flowrate, temperature, stage, and other important parameters will fluctuate throughout a single day and throughout the year. EPA chose conditions like the 7Q10 designed to replicate a worst-case scenario in order to account for the variability in ambient conditions.

Finally, the discharges were collectively modeled as a single theoretical discharge instead of modeled individually. The uncertainty of correctly modeling each separate discharge with realistic model inputs proved to be too challenging, therefore a single discharge location was chosen. This theoretical discharge accounted for all the runoff in the Lewiston MS4 and was placed farther downstream than the last discharge point in the City’s MS4. The modeled discharge point was placed near the center of the Snake River after its confluence with the Clearwater River because modeling a discharge point within either river prior to the confluence proved to be too difficult.

EPA made conservative assumptions for model inputs when possible in order to account for the uncertainty and difficulty associated with modeling the entire MS4 using CORMIX.

### 5.8.2 Toxicity Assessment

The largest single uncertainty in any toxicity assessment is the absence of any measured toxicity data for a species of interest. As a result, this required the use of toxicity data for surrogate species to estimate chemical effects on listed species evaluated within this BE.

EPA's aquatic life criteria are designed to protect 95% of aquatic genera from adverse effects, not 100% of aquatic species. Given this design, it is possible that one or more important prey species of a listed species within the Action Area not tested may be subject to toxic effects at chemical concentrations lower than the chronic NOEC. Loss of such species could reduce the prey base available to listed species.

Use of acute-chronic ratios (ACRs) to convert 96-hr $LC_{50}$ data to chronic maximum acceptable toxicant concentrations (MATC's) introduces uncertainties into the evaluation of the chronic criteria. A study by Raimondo et al. (2007) determined a geometric mean acute-chronic ratio of 8.3 from a data set of 456 same-species pairs of acute and maximum acceptable toxicant concentrations for metals, narcotics, pesticides, and other organic chemicals. ACR's smaller than 8.3, such as the chlorine ACR of 3.345, are often indicative of a chemical with a relatively steep dose response curve, meaning the difference between adverse and no adverse effect concentrations for a given species may be small.

There is great uncertainty regarding the lack of toxicity data for some species; therefore, data used in the effect analysis in the BE for listed species are from selected surrogate species. In some cases, no toxicity data was found for salmonid, and toxicity data from other species that are not salmonid are used.

Finally, the suite of stormwater pollutants is a mixture and predicting the chemical composition and concentration of the pollutants within a mixture is challenging and often not addressed in toxicity assessments. Chemicals with common modes of action will act jointly (additivity) to generate combination effects that are larger than the effects of each individual chemical in the mixture applied singly. Depending on the composition of the mixture, various interactions can occur including antagonism, potentiation, and synergism. There are true unknowns with the assessment of chemical mixtures and in this case, stormwater discharges; these include the toxic mode of action, exposure (concentration), and toxicity data that represent the pollutants in the stormwater. Whole effluent toxicity testing is used to assess the toxicity of chemical mixtures in wastewater discharge, this data is lacking for stormwater. Therefore, this toxicity assessment addresses the pollutants on an individual basis which may lead to an underestimation (potentiation) or underestimation (antagonism) of the toxicity.

### 5.8.3 Species Exposure Analysis

While the life history of the species is discussed in general terms there may be site specific behavior or habitat factors which limit or alter the species preferences. The Action Area is used to by both adult and juvenile salmonids for migration either upstream to spawn and out-migration from the natal streams. Out-migrants are feeding and rearing over the course of migration and utilize habitats that provide the functions and values necessary for successful rearing. We have assumed that outmigrants are exposed to the mercury in the zone of 0.1X dilution for a duration that is consistent with the duration of exposure assumed for the Interim RPA.

#### *5.8.3.a Hazard Assessment*

The hazard assessment conducted for listed species and their prey used effect levels generated through the toxicity assessment described in Section 5.3. The SLELs and PCLELs were used to develop the HQs using the deterministic risk assessment framework. There are modeling unknowns, variation unknowns and true unknowns associated with this process, these are addressed in the following sections.

### *5.8.3.b Development of Hazard Quotients*

There are uncertainties in the derivation of the HQs and a many of these uncertainties have been addressed within this Section; they include, the lack of toxicity data specific to ESA-listed species and the use of surrogate data; the use of ACRs; and, the inability to predict mixture effects. These uncertainties are centered on how effect levels for each pollutant for all the listed species evaluated in the BE were derived.

Actual testing of potential toxicity has not been conducted for all chemicals and ESA- listed species. While some toxicity data have been collected for nearly all of the focal pollutants, toxicity data are generally not available for every life stage or listed species (Table 5.6). In cases where little or no toxicity data are available for a life-stage of a listed species (e.g. juvenile Chinook), the available toxicity data for another species (e.g. fingerling rainbow trout) was used. It wasn't possible to generate species-specific HQs because other than Chinook and Vanadium there was no toxicity data unique to each species (Table 5.6). Therefore, we evaluated salmonids as a group and when possible selected data for rainbow trout; the closest taxonomic surrogate. Although using surrogate toxicity data from a similar species or life-stage increases the uncertainty associated with the BE, this approach is preferable to omitting the evaluation of a species or parameter with no toxicity data.

EPA developed HQ for salmonid prey categories to evaluate the likelihood of a reduction in the abundance of prey. However, there is uncertainty regarding the abundance of prey of listed species in the Basins evaluated in the BE, due to the quality of the habitat (riprap levee walls). Other community components can also indirectly affect an ESA listed species; however, species richness effects on communities is by far the most studied community structure metric used to evaluate biodiversity effects on ecosystem structure and function (Daam et al., 2019: van der Plas, 2019).

Reduction in the availability of prey for fish may result in reduced fish growth, fitness and density. The overall implication of potential reduction in the availability of prey for fish is that the indirect effect assessment for these salmonids are at best "probable" due to the unknowns presented by the lack of data on the abundance of prey species and toxicity data.

## 5.9 CUMULATIVE EFFECTS

Cumulative effects are defined at 50 CFR § 402.02 as those effects of future State or private activities, not involving federal activities, which are reasonably certain to occur within the Action Area of the Federal action subject to consultation. Since the Action Area, as described in Section 2.3, is within the confines of the lower Snake River and lower Clearwater River, extending 188m from the LLP West Levee Pond discharge location into the confluence of the Snake and LGDP, the cumulative effects would be those that affect those portions of the waterbodies. See Figure 2.2.

The proposed action is to issue two NPDES permits authorizing stormwater discharges from MS4s owned and/or operated by the City, LCSC, ITD2 in the Lewiston, Idaho, Urbanized Area (UA). There are other activities occuring on the landscape that are external to the EPA's Permit Action but could also impact the species. Section 2.3.6 provides a list of current and past activities that may impact ESA-listed species and that EPA anticipates would continue to occur within the Action Area. There are also non-Federal actions likely to occur that may have beneficial effects on ESA-listed species, such as implementation of riparian improvement measures, BMPs associated with timber harvests, animal grazing, agricultural activities, and nonpoint source pollution controls for urban development and road building activities.

The Port of Lewiston 2015 Strategic Marketing Plan[16] lists several goals and objectives that, in the absence of the need for a federal permit and once development occurs, may impact the lower Snake River. Broadly, some objectives include development and expansion of shipping opportunities; marketing the attributes of Port properties and facilities presumably for development and expansion; and increase customer base for intermodal transportation. While specific projects are not described, as economic opportunities improve, it is likely that additional Port development will take place.

The Clearwater Economic Development Association recently released the 2020-2025 Regional Strategy[17], however, this document also does not identify specific projects that could be considered in the cumulative effects analysis.

Finally, the Southeast Washington Economic Development Association Strategic Action plan[18] identified projects, which included dredging and general improvements to the Clarkston Port dock area and the cruise boat dock; continuing the acquisition, development, and management of the Port of Clarkston properties and facilities; construction of a boat launch; waterfront cleanup activities; and dredging near Asotin. All of the projects listed are short-term, likely to be completed within 5 years of startup. Some of the activities (dredging and improving docks) will required a federal permit, so those presumably will undergo Section 7 consultation, while others will be handled

[16] https://portoflewiston.com/our-port/strategic-marketing-plan/ Accessed by A. LaTier on August 3, 2020.
[17] http://www.clearwater-eda.org/regional-resourcesdownload-my-file/ Accessed by A. LaTier August 3, 2020
[18] https://seweda.org/wp-content/uploads/2018/12/2018-CEDS.pdf/

privately and can be considered cumulative effects. While there are not specific details to assess at this time, certainly cleaning up the waterfront and improving docks will result in beneficial effects to aquatic species.

There have been nominal annual growth rates observed in Lewiston, Idaho over the past ten years, on average a 0.36% increase year-over-year and a 3.7% increase over the past ten years (World Population Review, accessed 8/3/2020). It is reasonable to assume that these observed growth rates may continue, although there is insufficient information available to allow for a potential analysis of future growth, increased traffic, or new land development and/or road construction.

Table 5.30, below, lists existing known wastewater and stormwater dischargers within the Action Area. Note, at the time of reissuance, EPA was the NPDES permitting authority for the City of Lewiston WWTP and the City of Lewiston's Water Treatment Plant, this these actions and other Federal activities are not subject to a cumulative effects analysis. The permitting authority for publicly owned treatment works, industrial discharges, and NPDES general permits transferred to the IPDES Program on July 1, 2018, July 1, 2019, and July 1, 2020, respectively. As noted in Section 2.1, IDEQ will obtain permitting authority for stormwater discharges (municipal, construction, and industrial) in Idaho on July 1, 2021. Until that time, EPA remains the NPDES permitting authority for the Permit Actions described in this BE.

***Table 5.30. List of existing wastewater and industrial stormwater dischargers in the Action Area.***

| **Facility** | **Permit Number** | **Permit Type** | **Receiving Water** |
|---|---|---|---|
| Lewiston WWTP | ID0022055 | POTW | Clearwater River |
| Clarkston WWTP | WA0021113 | POTW | Snake River |
| City of Lewiston Water Treatment Plant | IDG380003 | Drinking Water Treatment Plant | Clearwater River |
| Clearwater Paper Corporation | ID0001163 | Industrial | Snake River |
| Pacific Steel and Recycling | IDR053088 | Industrial Stormwater | Clearwater River |
| Herco, Inc. Asphalt Paving Plant | IDR053215 | Industrial Stormwater | Clearwater River |
| Clearwater Paper Corp. | IDR053113 | Industrial Stormwater | Lost Creek Wetland |
| Port of Lewiston | IDR053166 | Industrial Stormwater | LLPs, LGDP |
| Port of Lewiston | IDR053167 | Industrial Stormwater | LLPs, LGDP |
| Port of Lewiston | IDR053168 | Industrial Stormwater | LLPs, LGDP |

Pursuant to 50 CFR § 402.14(c)(2), EPA is incorporating by reference the Clearwater Paper Mill BE (Clearwater BE), which includes a detailed discussion on atmospheric deposition and temperature modeling of the confluence of the Snake and Clearwater Rivers. Please refer to Section 4.3.1. of the Clearwater BE for that additional information. (USEPA, 2019c).

EPA is unaware of any other currently planned or future activities that are reasonably certain to occur, based on clear and substantial information, in the Action Area that could affect listed species.

## 5.10 EFFECT DETERMINATIONS FOR LISTED SPECIES

This section consists of the culmination of the direct and indirect effects of the Proposed Actions on listed species. There are three possible determinations of effects under the ESA (USFWS and NMFS, 1998). The determinations and their definitions are:

- **No Effect (NE)** – the appropriate conclusion when the action agency determines its proposed action will not affect ESA-listed species or critical habitat.

- **May affect, not likely to adversely affect (NLAA)** – the appropriate conclusion when effects on ESA-listed species are expected to be discountable, or insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

- **May affect, likely to adversely affect (LAA)** – the appropriate conclusion if any adverse effect to ESA-listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the ESA-listed species, but also is likely to cause any adverse effects, then the proposed action "is likely to adversely affect" the ESA-listed species. An "is likely to adversely affect" determination requires formal section 7 consultation.

The determination of whether listed species are likely to be adversely affected must be based on clear and substantial information using the best scientific and commercial data available. For this BE, EPA evaluated the potential consequences to ESA-listed species as a result of exposure to municipal stormwater discharges (considering the size of the plumes relative to the salmonid swimming speed); direct toxicity to the species itself; and effects through toxicity to prey species.

EPA concluded that there was a low likelihood of exposure to adult Snake River Chinook (fall/spring/Summer runs), Snake River Sockeye and both sub-adult and adult Columbia River bull trout.

EPA based this likelihood of exposure on the following:

- Documented travel time from the confluence of the Clearwater and Snake Rivers and Lower Granite Dam to determine the duration of exposure in the Action Area and specifically in the nearfield discharge zones.
- The quality of the habitat to provide for essential behaviors of migrating adults.
- The water depth where migrating adults would swim relative to the anticipated location of the discharges in the water column due to buoyancy.
- The proportion of the nearfield dilution zone relative to the portion of the Action Area within the confluence of the Snake River and the Clearwater River where fish have been documented to hold.
- Likely preferential use of higher quality habitat along the west shoreline of the Snake River away from discharge locations.
- Preference for the deeper cooler part of the river channel by adult salmonids particularly during summer months reducing exposure to the nearfield stormwater plume.
- The ability of adults and subadults, which are more mobile, to avoid the stormwater plumes, particularly when the temperature is elevated above ambient water temperature.

EPA conducted the species response analysis for sub-yearling Fall/Spring/Summer Chinook, Snake River Sockeye smolts and adult and juvenile Snake River Steelhead. The analysis incorporated conservative assumptions and, in many cases, resulted in an overestimation of focal pollutant concentration and exposure durations, including:

- The swimming speed varies according to the magnitude of the flow and where possible; we used the highest flow for the slowest swimming speed to conservatively predict exposure.
- Tier I EPCs developed using the geometric mean of the maximum focal pollutant concentrations in each Basin, which was considered a conservative worst-case scenario.
- The Mercury Interim RPA is based on trophic level 4 fish; juvenile salmonids do not feed this high on the food chain; therefore, this RPA may be overprotective of these lifestages.
- Where total inorganic mercury was not detected in the stormwater data sets; we used the maximum reporting limit as the concentration to calculate the geometric mean of the discharge concentration, rather than ½ the detection limit which is more common (Section 5.2.2).

Other considerations for determining whether there would be adverse consequences to ESA-listed species from exposure to focal pollutants in stormwater discharges included:

- Flow from the LLPs is less than 0.01 of the flow of the Clearwater River resulting in an insignificant contribution of concentration and load to the River.
- The loading of total inorganic mercury to the Clearwater River and Snake River for the two modeled storm events is considered immeasurable relative to background mercury levels.
- Based on the effectiveness of the stormwater management control measures to be implemented by the Permittees, compliance with the Permit will reduce sediment and particulate loading, and thereby total mercury, by 10 to 28 percent.
- Modeling the nearfield (0.1X dilution) stormwater plume as a single continuous discharge from outfall location rather than eight (8) discrete discharge results in an overestimation of this area of potentially elevated pollutant concentrations.
- Delineating the downstream extent of the Action Area was accomplished by modeling a continuous discharge from a single, large diameter pipe.
- The Mercury Interim RPA is close to background concentrations for other locations in the Snake and Boise River leading to background HQs that are comparable to the HQs as a result of the Action at those locations; we used the lowest background number to represent the Action Area.
- Although the HQs for total mercury are slightly elevated, they are less than 2.0 and were based on a number of a conservative assumptions that overestimated the total mercury concentration in the stormwater runoff and do not definitively lead to unequivocal adverse effects.
- Focal pollutants in stormwater discharges are not expected to cause a significant reduction in ESA-salmonid prey species populations.

Results of the temperature analysis resulted in the following conclusions:

- Although the measured temperatures of some of the stormwater ponds exceeded temperature benchmarks, it is unlikely that general stormwater runoff from the City/LCSC and ITD #2 would reach these temperatures.
- Temperature contributions to the receiving waters from stormwater discharges would be minimal given the insignificant runoff rates as compared to the 49,800 cfs mean annual flow of the river.

EPA does not have a firm basis to support a conclusion that adverse consequences of the Permit Actions is reasonably certain to occur, particularly, due to the lack of site-specific data for total mercury. As a result, and given the assumptions and considerations noted above, particularly, the magnitude of the HQs, the estimated exposure durations, and the chronic NOECs used, EPA made the following effect determinations (Table 5.31):

***Table 5.31. Effects Determinations***

| **Species** | **Population** | **Effects Determination Species** | **Effects Determination Critical habitat** |
|---|---|---|---|
| Chinook salmon | Snake River Spring/Summer ESU | NLAA | NLAA |
| | Snake River Fall ESU | NLAA | NLAA |
| Sockeye salmon | Snake River ESU | NLAA | NLAA |
| Bull trout | Columbia River DPS | NLAA | NLAA |
| Steelhead | Snake River ESU | NLAA | NLAA |
| Spalding’s catchfly | West-central Idaho | NE | CH not designated |

NE = No Effect
NLAA = Not Likely to Adversely Affect
LAA = Likely to Adversely Affect

# 6. ESSENTIAL FISH HABITAT

In this section, Essential Fish Habitat (EFH) is assessed for potential adverse impacts from the issuance of the following NPDES permits for storm water discharges from MS4s in the Lewiston Urbanized Area:

- NPDES Permit No. IDS028061 City of Lewiston and Lewis-Clark State College, ID
- NPDES Permit No. IDS028058 Idaho Transportation District #2

The Action Agency in this matter is U.S. EPA Region 10 (EPA)

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires Federal agencies to consult with NMFS on activities that may adversely affect EFH. The objective of this EFH assessment is to determine if the proposed action may "adversely affect" designated EFH for relevant commercially- or federally managed fisheries species within the Action Area. It also describes conservation measures proposed to avoid, minimize or otherwise offset potential adverse effects to designated EFH resulting from the proposed action.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. EFH covers a species' full life cycle and EFH waters may include:

- Aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish, where appropriate;
- Substrate, including sediment, hard bottom, structures underlying the waters, and associated biological communities; and
- Habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem.

Adverse effect means any impact, which reduces quality and/or quantity of EFH, and may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey or reduction in species fecundity), site-specific, or habitat-wide impacts, including individual, cumulative or synergistic consequences of actions (50 CFR 600.810).

Pursuant to the MSA the Pacific Fisheries Management Council (PFMC) has designated EFH for three species of Federally- managed Pacific salmon: chinook (*Oncorhynchus tshawytscha*); coho (*O. kisutch*); and Puget Sound pink salmon (*O. gorbuscha*) (PFMC, 2014; PFMC, 2016). Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers (as identified by PFMC 2014), and longstanding, naturally-impassable barriers (i.e. natural waterfalls in existence for several hundred years).

## 6.1 DESCRIPTION OF THE PROJECT/PROPOSED ACTIVITY

As described in Section 2.2 of this document, EPA is proposing to issue two NPDES permits for storm water discharges from MS4s in the Lewiston, Idaho urbanized area. These permits will authorize discharge from MS4s into the Snake River, the Lower Granite Dam Pool, Tammany Creek, and Lindsay Creek.

The City, Lewis-Clark State College, and ITD2 own and/or operate their MS4s in Nez Perce County, Idaho. The City and LCSC MS4s drain approximately 9.7 square miles, with approximately 115,000 feet of storm sewer in place throughout the City. Most surface drainage is conveyed through privately-owned natural drainage ways. ITD2's MS4 drains approximately 0.367 square miles and consists of road segments, primarily U.S. and State highways within the Lewiston UA. Most of the known MS4 outfalls convey runoff to the LLPs owned and operated by USACE, where the water is then pumped from the ponds into the LGDP. (USEPA, 2018). See Section 2.2.

## 6.2 POTENTIAL ADVERSE EFFECTS OF PROPOSED PROJECT

The Action Area is designated as EFH for chinook salmon and coho salmon (NMFS, 2020; PFMC, 2014).

- Chinook salmon are in the Action Area during various life history stages throughout the year. See Sections 5.6.5 and 5.6.6.
- Coho salmon (wild stocks) have been extinct in the Snake River basin since 1986. However, the Nez Perce Tribe initiated a reintroduction program for Coho salmon in the Clearwater subbasin in 1995. Data collected from PIT tags in 2014 indicated that 40,000 Clearwater coho adults passed Bonneville Dam with over 18,000 of them making it past Lower Granite Dam, the majority returning through the Action Area to Lapwai and Clear Creeks on the Nez Perce reservation where most of them were released as juveniles. Additionally, natural production of coho salmon has been documented in Lolo Creek, Potlatch River, Catholic Creek, and in the North Fork Clearwater River (all tributaries to the Clearwater River located outside of the Action Area), and also in the Tucannon River (a tributary to the Snake River, outside of the Action Area). (Nez Perce Tribe and Columbia River Inter-Tribal Fish Commission, 2014).

Water quality is an important component of EFH. The effects of the authorized MS4 discharges to Chinook salmon EFH and Coho salmon EFH within the Action Area are the same as those described for fish species in Sections 5.6 and 5.7. A summary of the determinations made for threatened and endangered salmonids is found in Section 5.10.

Using the information presented in Sections 5.6 and 5.7, EPA concludes that its issuance of NPDES Permit #IDS028061 to the City of Lewiston and Lewis-Clark State College, and NPDES Permit #IDS028258 to Idaho Transportation District #2 is **not likely to adversely affect** Chinook salmon EFH and Coho salmon EFH in the Action Area. EPA provided NMFS with copies of each draft permit and fact sheet during the public comment periods. Any recommendations received from NMFS regarding EFH will be considered by EPA prior to issuance of the permits.

### 6.3 EFH CONSERVATION MEASURES

PFMC 2014 describes over thirty non-fishing activities that may adversely affect salmon EFH, and for each of these activities, identifies potential measures to conserve EFH. Below are the EFH conservation measures that are addressed by NPDES Permit #IDS028061and NPDES Permit #IDS028258 that will minimize adverse effects to Chinook salmon and Coho salmon EFH.

- Plan development sites to minimize clearing and grading and cut-and-fill activities; Use BMPs in building as well as road construction and maintenance operations such as avoiding ground disturbing activities during the wet season, minimizing the time disturbed lands are left exposed, using erosion prevention and sediment control methods, minimizing vegetation disturbance, maintaining buffers of vegetation around wetlands, streams and drainage ways, and avoiding building activities in areas of steep slopes with highly erodible soils. Use methods such as sediment ponds, sediment traps, or other facilities designed to slow water run-off and trap sediment and nutrients. Implement Low Impact Development construction practices to the maximum extent possible.
    - Each Permit requires the Permittees to impose comprehensive, jurisdiction-wide requirements for the use of appropriate BMPs such as erosion and sediment controls to reduce pollutants in runoff from active construction sites. The Permits also require Permittees to mandate that new development and redevelopment projects be designed and constructed to retain runoff onsite to the extent feasible, and to incorporate techniques for runoff treatment where retention is infeasible. See Sections 2.2.3 and 2.2.4, particularly 2.2.4.c and 2.2.4.d.
- Monitor water quality discharges following National Pollutant Discharge Elimination System requirements
    - The Permits require the City/LCSC to conduct a storm water monitoring/assessment program. Monitoring of stormwater outfalls will help to better characterize the quality of MS4 discharges into Lindsay Creek and Snake River; information gathered will be used to establish a baseline from which EPA can characterize the effectiveness of controls required in the Permit.
- Apply management measures to control pollution in watersheds with salmon EFH
    - The Permittees must implement comprehensive SWMPs to reduce pollutants in the storm water discharges to the maximum extent practicable as required by the CWA. See Sections 2.2.3 and 2.2.4.
- For those water bodes that are defined as water quality limited according to the Idaho CWA 303(d) list, establish TMDLs and develop appropriate management plans to attain management goal

- IDEQ has completed TMDLs for bacteria, sediment and nutrients in Lindsay Creek and sediment in Tammany Creek; a TMDL for temperature impacts in the Snake River is anticipated to be completed in the next five years. See Section 2.3.5.

## 6.4 CONCLUSION

EPA concludes that the proposed actions to issue two NPDES permits for storm water discharges from NPDES-regulated MS4s in the Lewiston Urbanized Area are not likely to adversely affect EFHs for Chinook salmon and Coho salmon.

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# APPENDIX 1 CORMIX MODELING

EPA used the CORMIX model (version 11.0) to delineate the downstream extent of the Action Area. CORMIX is a comprehensive software system for the analysis, prediction, and design of outfall mixing zones resulting from discharge of aqueous pollutants into diverse water bodies. The preliminary results of the Toxicity Assessment were used to identify the focal pollutant with the greatest potential to impact ESA-listed species to drive this modeling effort, which, in this case, was total inorganic mercury.

The downstream boundary of the Action Area is, therefore, defined as the distance a stormwater plume would travel before reaching the benchmark THg concentration of 0.002 ppb, based on the Interim RPA for mercury.

As described previously, the analysis was performed as if all discharges from the MS4s' conveyance were connected to a single outfall located in the middle of the confluence of the Snake and Clearwater Rivers. Accurately modeling all MS4 discharges separately proved to be too difficult, therefore EPA determined modeling them as a single discharge would be effective in determining the extent of the Action Area.

The simulations were repeated with six different pipe diameters and for two discharge flow rates based on the 2-year, 6-hour and 2-year, 24-hour storm events.

## A. MODEL INPUTS AND ASSUMPTIONS

The CORMIX model inputs and their bases are described below.

### 1. Effluent Tab

EPA based the extent of the downstream Action Area on the parameter of greatest concern, THg. Based on the estimated EoP concentration for THg and the Toxicity Assessment, the calculated HQs for THg were greater than for any other focal pollutant. The discharge was modeled as a conservative pollutant since most metals are typically conservative. The highest estimated THg EoP concentration was 0.038 µg/L found in Basin #12.

CORMIX provides the option to model the discharge concentration as "excess over the background concentration." As noted in Section 5.5.2.b, the mercury background concentrations for National Rivers and Streams, the Snake River within Brownlee Reservoir and further upstream in the Snake River and Boise Rivers are comparable (1.5 ng/L) to the Interim RPA of 2.0 ng/L. However, EPA made the conservative assumption for this modeling effort to establish a background concentration of 0 µg/L and an EoP concentration of 0.04 µg/L (just rounding to limit significant digits due to uncertainty).

The effluent flow rate was varied for the two storm scenarios considered in the loading analysis (2-year, 6-hour storm and 2-year, 24-hour storm). The effluent flow rate was determined using the SCS CN Method as described in the loading analysis section

(Section 5.2.4). The following equation was used to calculate the effluent flow rate if the stormwater runoff was discharged from a single outfall:

$$Effluent\ Flow\ Rate = \frac{[(Q_{LDR} * a_{LDR} + Q_{HDR} * a_{HDR} + Q_{COM} * a_{COM} + \cdots) * Area_{total}]}{t_i} * c$$

Where $Q$ is the estimated runoff from a given land use and storm event (inches), $a$ is the percent area of a land use for the entire MS4, $Area_{total}$ is the total area of the MS4, $t_i$ is the length of storm event *i* (seconds), and *c* is a conversion factor for units. An important assumption of this equation is that for the 2-year, 6-hour storm event, all runoff is discharged uniformly over 6 hours and for the 2-year, 24-hour storm event, all runoff is discharged uniformly over 24 hours. Using this assumption and the above equation EPA estimated the following flow rates used in the CORMIX analysis:

| Storm Event | Effluent Flow Rate |
|---|---|
| 2-year, 6-hour (0.79 inches) | 2.1 $m^3$/s |
| 2-year, 24-hour (1.21 inches) | 1.7 $m^3$/s |

The effluent temperature was used to specify the effluent density. Air temperature measured at station USW00024149 from 4/1/1998-5/16/2020 was used to estimate runoff temperature (NOAA, 2020). Impervious surfaces like those found in urban areas are known to heat rainfall prior to discharge/runoff. As described in *Modeling Thermal Enrichment of Streams due to Solar Heating of Local Urban Stormwater* (James et al. 1999) the following equation relates temperature of runoff ($T_R$) to temperature of wet pavement ($T_{pw}$):

$$T_R = 3.26 + 0.828 * T_{pw}$$

Furthermore, measurements have shown pavement temperature to be between 8 and 9°C warmer than air temperature ($T_A$). Taking the average of 8 and 9 and substituting this relationship into the above equation yields:

$$T_R = 3.26 + 0.828 * (T_A + 8.5)$$

The average air temperature from NOAA station USW00024149 was found to be 12.3°C. Using the above equation, the average runoff temperature is 20.5°C.

***Table A.1. Summary of Effluent Tab Inputs.***

| Input Name | Value | Source / Basis |
|---|---|---|
| Pollutant Type | conservative | Metals are typically conservative pollutants. |
| Discharge Concentration Excess | 0.04 ppb | Maximum Estimated EoP Concentration |
| Effluent Flow Rate | Variable (2.1 $m^3$/s, 1.7 $m^3$/s) | Millier et al. (1973)<br>USDA (1972) |
| Effluent Temperature (Freshwater) | 20.5 °C | James et al. (1999)<br>NOAA (2020) |

## 2. Ambient Tab

EPA modeled the discharge scenarios in the middle of the Snake River just after the confluence with the Clearwater River. The Lewiston Area MS4s have multiple discharge points throughout their jurisdictions, however, as described above, EPA chose to model all the discharges at a single discharge point. Consistent with EPA's 2019 Clearwater Paper Fact Sheet, downstream conditions were modeled as mixing interactions occur downstream from the point of discharge (USEPA, 2019b). EPA chose the same discharge point as the 2019 Clearwater Paper Fact Sheet (cross section 139.22). The average depth and depth at discharge for this location is 9.14 meters (USACE, 1972a; USACE, 1972b)).

Wind speed was given as 2 meters per second as recommended by the CORMIX user manual when field data are unavailable (Doneker et al., 2014).

The width of the Snake River at cross section 139.22 is approximately 610 meters (USACE, 1972).

All CORMIX models were run as a uniform ambient appearance. Complete mixing for each scenario occurs within several hundred meters. The Snake River immediately downstream of its confluence with the Clearwater River is uniform. Any meandering in the river occurs farther downstream than the furthest point of complete mixing for all scenarios.

EPA used the 7-day, 10-year flow (7Q10) as the ambient flow rate. The 7Q10 flow rate was calculated downstream of the point of discharge on the Snake River at USGS station 13343500 SNAKE RIVER NEAR CLARKSTON, WA (USGS 1973). The USGS Surface Water Toolbox (Kiang et al. 2018) was used to calculate the 7Q10 at this point using 59 years of streamflow data from 1916-1972. For this period of record, the USGS Surface Water Toolbox calculated a 7Q10 of 12,853 cfs (equivalent to 364 $m^3/s$).

EPA used the CORMIX User Manual's recommended Manning's n of 0.0025 for an earthen channel with some stones and weeds (Deoneker et al. 2014).

Data from two contemporaneous temperature data sets were used to determine the ambient water temperature, USGS 13334300 SNAKE RIVER NEAR ANATONE, WA (9/30/2008 – 5/21/2020) and USGS 13343000 CLEARWATER RIVER NEAR LEWISTON, ID (9/30/2020 – 5/21/2020). The average temperature of the Snake River during this time was 11.6°C and the average temperature of the Clearwater was 10.3°C. EPA took the average of all the data from both stations as the input ambient water temperature, a value of 11.2°C. Both stations are located upstream of the theoretical point of discharge EPA used in the model. EPA assumed no thermal stratification after the point of discharge in the Snake River.

| ***Table A.2. Summary of Ambient Tab Inputs*** | | |
|---|---|---|
| **Input Name** | **Value** | **Source / Basis** |
| Average Depth | 9.14 m | USACE (1972)<br>USEPA (2019) |
| Depth at Discharge | 9.14 m | USACE (1972)<br>USEPA (2019) |
| Wind Speed | 2 m/s | Doneker et al. (2014) |
| Width (Bounded) | 610 m | USACE (1972)<br>USEPA (2019) |
| Appearance | Uniform | Snake River is uniform after confluence with Clearwater |
| Flowrate (Steady) | 364 $m^3$/s | Kiang et al. (2018)<br>USGS (1973) |
| Manning's n | 0.025 | Doneker et al. (2014) |
| Ambient Water Temperature (Freshwater – Uniform) | 11.2 °C | USGS (2020a)<br>USGS (2020b) |

## 3. Discharge Tab

EPA selected the "CORMIX1" option because most MS4 discharges are single port discharges.

EPA modeled all scenarios as if all runoff was discharged through a single port in the middle of the Snake River just after the confluence with the Clearwater River. CORMIX does not allow a discharge point to occur exactly in the middle of a channel, therefore, EPA chose to "move" the theoretical discharge point slightly to the right (as one looks downstream). Therefore, the point of discharge was modeled at 300 meters from the right bank and 310 meters from the left bank (total stream width as described above is 610 meters).

The Vertical Angle, THETA, is the angle between port centerline and the horizontal plane. Because it is most likely that a stormwater pipe would be horizontal, THETA was set as 0 degrees.

The Horizontal Angle, SIGMA, is the horizontal angle measured clockwise from the ambient current direction to the port centerline direction. Zero degrees represents the port pointing in the downstream direction in a co-flowing direction with the current and 90 degrees represents the port pointing perpendicular to, and to the left of, the ambient flow facing downstream in the current direction. EPA modeled SIGMA as 90 degrees after typical MS4 discharges.

Port diameters in the Lewiston MS4 and those discharging stormwater from levee ponds are likely to range from 12 inches to 54 inches (Lewiston, 2001; USACE, 1972). EPA varied port diameter from 24 inches to 54 inches in 6-inch intervals for a total of six scenarios for each storm event (12 scenarios total). EPA did not include results from the 12-inch and 18-inch port diameter runs due to unrealistic model outputs. As port diameter shrinks, the velocity of the discharge increases. For the 12- and 18-inch scenarios, EPA found immediate and complete mixing upon discharge into the receiving water.

Port height above the channel bottom measures the distance from the channel bottom to the port centerline and was also varied, but with a constant definition. EPA maintained the top of the port at the surface of the Snake River for all model runs. Each run modeled the port as submerged (albeit just barely). This means that for each run the Port height above channel bottom = Depth at discharge -0.5*Port Diameter. In trial runs, EPA found that discharges above the surface of the receiving water and ports significantly submerged resulted in more mixing than those found just submerged.

***Table A.3. Summary of Discharge Tab Inputs***

| Input Name | Value | Source / Basis |
|---|---|---|
| Discharge Geometry Data | CORMIX 1 Single Port | Doneker et al. (2014) |
| Nearest bank is on the | Right | Assumed scenario |
| Distance to nearest bank | 300 m | Assumed scenario |
| Vertical Angle THETA | 0° | Stormwater pipes are likely to be horizontal |
| Horizontal Angle SIGMA | 90° | Stormwater pipes are likely to be perpendicular to receiving water |
| Port Diameter | Variable (24 in, 30 in, 36 in, 42 in, 48 in, 54 in) | Lewiston (2001)<br>USACE (1972) |
| Port Height Above Channel Bottom (Submerged) | Variable with Port Diameter (Port Height = Depth at Discharge – Port Diameter/2) | Assumption of worst case scenario |

## 4. Mixing Zone Tab

The effluent was modeled as “Toxic,” which allows the option to enter a Criterion Maximum Concentration (CMC) and a Criterion Continuous Concentration (CCC). When either the CMC or CCC is reached after discharge, the model output will note the location. EPA used the mercury benchmark value of 0.002 µg/L (or 0.002 ppb), based on the Interim RPA, as the CCC to determine the furthest distance downstream where the discharge could have an effect on ESA listed species. As noted above, EPA used an estimated EoP concentration of 0.04 µg/L (or 0.04ppb) for the modeling effort. Therefore, the 0.1X concentration would be 0.004 µg/L (or 0.004ppb), which EPA used as the CMC value to delineate the downstream distance to the 0.1X dilution boundary.

The region of interest was specified as 7000 meters because CORMIX requires a downstream region of interest at least 100 times greater than the channel width (Channel width = 610 meters). The output steps per module has no bearing on the outcome of the model run, it only provides a level of detail in the output files. EPA selected 100 output steps per module in order to effectively determine downstream locations where the 0.1X dilution and benchmark value for mercury occur.

***Table A.4. Summary of Mixing Zone Tab Inputs***

| Input Name | Value | Source / Basis |
|---|---|---|
| CMC | 0.004 ppb (placeholder for 0.1X Dilution) | HQ@0.1X from End of Pipe, Hazard Quotient Analysis |
| CCC | 0.002 | Interim RPA for mercury – chemical with highest HQ |

| | | |
|---|---|---|
| Region of Interest (No Mixing Zone Specified) | 7000 m | Sufficiently far downstream after complete mixing occurs |
| Output Steps per Module | 100 | Provides sufficient output detail |

## B. RESULTS

Each CORMIX run produces in an output report that summarizes information on “concentration excess” for a pollutant (i.e. the difference between the ambient concentration and the modeled discharge concentration) in the receiving water at various points downstream. EPA modeled each scenario with the ambient THg concentration of the receiving water set to 0 µg/L, therefore the EoP concentration is equivalent to concentration excess. Important downstream distances of note are: 1) the downstream distance where concentration excess equals the 0.1X dilution, 2) the downstream distance where the near field region ends, and 3) the downstream distance where concentration excess equals the benchmark concentration. The near field region is *“a term used in the CORMIX printout for describing the zone of strong initial mixing where the so called near-field processes occur”* (Doneker et al. 2014). For EPA’s 12 CORMIX scenarios mixing characteristics and concentrations over distance are relatively uncertain within the near field region when compared to those after the end of the near field region. In instances where the benchmark concentration was met before the end of the near field region, EPA chose to assume the benchmark concentration was reached at the near field boundary due to this uncertainty.

As noted above, EPA ran twelve modeling scenarios that estimated stormwater plume lengths as a result of discharges during two defined storm events and from six different outfall diameters (port diameters). Table A.5 summarizes the results of this modeling effort for both the 2-year, 6-hour and 2-year, 24-hour storm events and the six different port diameters that were considered.

***Table A.5. CORMIX Results***

| Run # | Port Diameter (in) | Downstream Distance to 0.1X Dilution (m) | End of Near Field Region (m) | Downstream Distance to Benchmark Concentration (m) |
|---|---|---|---|---|
| **2-year, 6-hour Storm Event (Discharge Flowrate = 2.1 $m^3/s$).** | | | | |
| 1 | 24 | 3.5 | 89 | 13 |
| 2 | 30 | 6.5 | 52 | 16 |
| 3 | 36 | 10 | 32 | 31 |
| 4 | 42 | 14 | 22 | 79 |
| 5 | 48 | 18 | 24 | 126 |
| **6** | **54** | **21** | **26** | **188** |
| **2-year, 24-hour Storm Event (Discharge Flowrate = 1.7 $m^3/s$)** | | | | |
| 7 | 24 | 4.3 | 54 | 15 |
| 8 | 30 | 7.6 | 30 | 19 |
| 9 | 36 | 12. | 23 | 36 |
| 10 | 42 | 15 | 26 | 60 |

| | | | | |
|---|---|---|---|---|
| 11 | 48 | 19 | 28 | 85 |
| 12 | 54 | 22 | 30 | 111 |

For the 2-year, 6-hour storm, the downstream distances where the predicted THg concentration excess meets the 0.1X dilution and the benchmark concentration increase as port diameter increases. The end of the near field region, however, decreases as port diameter increases. For the same flow rate, velocity decreases as port diameter increases. A lower discharge velocity will typically result in a relatively weaker initial mixing zone (in the near field) due less momentum flux. Therefore, the near field region (a zone of strong initial mixing) decreases and downstream distances to the 0.1X dilution and benchmark concentration increase as discharge velocity decreases.

For the 2-year, 24-hour storm, the downstream distances increase as port diameter increases and the near field region typically shrinks as port diameter increases. Most runs, but not all, for the 2-year, 24-hour storm event results in shorter distances downstream to the benchmark concentration when compared to the 2-year, 6-hour run of the same port diameter. This is likely due to a lower flowrate for the 2-year, 24-hour storm (1.7 $m^3/s$ compared to 2.1 $m^3/s$). Despite the 2-year, 24-hour storm event resulting in greater runoff than the 2-year, 6-hour storm event (1.2 inches compared to 0.79 inches) the rainfall is averaged over a longer period of time (24 hours compared to 6 hours) resulting in an overall lower flowrate.

To delineate the downstream extent of the Action Area, EPA used the modeling results to determine the distance downstream of the discharge point where the concentration excess equals the benchmark concentration and, as noted above, does not occur within the near field region (Table A.6).

***Table A.6. Modeled Action Area Downstream Extent for Each CORMIX Run***

| **Run #** | **Storm Event** | **Port Diameter (in)** | **Action Area Distance Downstream (m)** |
|---|---|---|---|
| 1 | 2-year, 6-hour | 24 | 89 |
| 2 | 2-year, 6-hour | 30 | 52 |
| 3 | 2-year, 6-hour | 36 | 32 |
| 4 | 2-year, 6-hour | 42 | 79 |
| 5 | 2-year, 6-hour | 48 | 126 |
| **6** | **2-year, 6-hour** | **54** | **188** |
| 7 | 2-year, 24-hour | 24 | 54 |
| 8 | 2-year, 24-hour | 30 | 30 |
| 9 | 2-year, 24-hour | 36 | 36 |
| 10 | 2-year, 24-hour | 42 | 60 |
| 11 | 2-year, 24-hour | 48 | 85 |
| 12 | 2-year, 24-hour | 54 | 111 |

Based on these results, EPA defined the downstream Action Area boundary as the point 188 meters from the confluence, which was the largest distance modeled. It is important to note that the MS4s do not discharge directly to the confluence area, therefore this downstream boundary is further from the true points of discharge. Figure 5.7 in Section 5.4.4 depicts the spatial extent of the 0.1X dilution area as a result of this modeling effort.

# APPENDIX 2 DRAFT PERMITS AND FACT SHEETS

*Due to the size of these files, the Permits and Fact Sheets are attached separately. They can also be located at the following websites:*

*https://www.epa.gov/npdes-permits/draft-npdes-stormwater-permit-city-lewiston-and-lewis-clark-state-college-idaho*

*https://www.epa.gov/npdes-permits/draft-npdes-stormwater-permit-idaho-transportation-department-district-2*