In Reply Refer to:
FWS/R1/2022-0044643

Michael S. Erickson
Chief, Environmental Compliance Section
U.S. Army Corps of Engineers, Walla Walla District
201 North Third Avenue
Walla Walla, Washington 99362-1876

Dear Mr. Erickson:

Subject: Snake River Channel Maintenance Project

This letter transmits the U. S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) on the U.S. Army Corps of Engineers (Corps) proposed Snake River Channel Maintenance Project located along the Snake River in Walla Walla County, Washington, and its effects on bull trout (*Salvelinus confluentus*) and designated bull trout critical habitat. Formal consultation on the proposed action was conducted in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). Your April 25, 2022, request for formal consultation was received on April 26, 2022.

On November 20, 2014, the Service issued a biological opinion that represented a first-tier of a programmatic consultation and addressed the framework programmatic action to address sediment accumulation interfering with authorized Lower Snake River Project purposes, such as commercial navigation. In our first-tier biological opinion, we concluded that the adoption of a programmatic sediment management plan (PSMP) would not jeopardize the continued existence of the species or result in destruction or adverse modification of designated critical habitat (USFWS 2014a). At the broad scale, the PSMP did not authorize any action under the PSMP, but contained a set activities that may occur under the plan. The biological opinion on the PSMP determined that there was insufficient detail to quantify project-specific take at the time, but determined there was sufficient detail to determine take at the plan level and an incidental take statement was issued. The incidental take statement accompanying the first-tier biological opinion did not authorize any incidental take resulting from site-specific actions.

Programmatic consultation may require section 7(a)(2) analyses at both the program level and the tiered site-specific level to ensure compliance with section 7(a)(2) of the Act (84 FR 44976). The PSMP first-tier programmatic envisioned the need for future second-tier consultation to confirm the extent of take and evaluate other site-specific effects to bull trout and designated bull trout critical habitat that could not be fully evaluated at the time. The enclosed Opinion represents the second-tier consultation on the Corps' Snake River Channel Maintenance Project, proposed for implementation under the first-tier PSMP biological opinion. This Opinion is based on site-specific information provided in the Corps' Snake River Channel Maintenance Biological Assessment, additional information received by email, telephone conversations, field investigations, and other sources of information cited in the Opinion. A complete record of this consultation is on file at the Service's Eastern Washington Field Office in Spokane, Washington. An electronic copy of this Opinion will be available to the public approximately 14 days after it is finalized and signed. A list of Biological Opinions completed by the Service since October 1, 2017, can be found on the Service Environmental Conservation Online System (ECOS) website at https://ecos.fws.gov/ecp/report/biological-opinion.html.

The Corps also concluded a "no effect" determination for Spalding's catchfly (*Silene spaldingii*) and yellow-billed cuckoo (*Coccyzus americanus*). There is no requirement for concurrence by the Service on "no effect" determinations. Therefore, the determination rests with the action agency.

If you have any questions regarding the enclosed Biological Opinion or our shared responsibilities under the Act, please contact Kat Sarensen at (509) 795-4776, or katherine_sarensen@fws.gov.

Sincerely,

JEFFREY KRUPKA

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Date: 2022.08.24 09:49:08 -07'00'

Brad Thompson, State Supervisor
Washington Fish and Wildlife Office

Enclosure(s)

cc:
USACE, Walla Walla, WA (B. Tice)
NMFS, Moscow, ID (J. Mital)

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
2022-0044643
Cross Reference Number: 01EWFW00-2014-F-0660

Snake River Channel Maintenance Project

Walla Walla County, Washington and Nez Perce County, Idaho

Federal Action Agency:

U.S. Army Corps of Engineers

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Spokane, Washington

JEFFREY KRUPKA
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Brad Thompson, State Supervisor
Washington Fish and Wildlife Office

Date

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ACRONYMS AND ABBREVIATIONS

BA	Biological Assessment
BMP	Best Management Practices
CFR	Code of Federal Regulations
CHSU	Critical Habitat Subunit
CHU	Critical Habitat Unit
Corps	U.S. Army Corps of Engineers
cy	cubic yards
dB	decibel
ESA	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)
FMO	Foraging, Migration and Overwintering
FR	Federal Register
LWD	Large Woody Debris
MCRU	Mid-Columbia Recovery Unit
MOP	Minimum Operating Pool
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
Opinion	Biological Opinion
PCB	Polychlorinated biphenyls
PCE	Primary Constituent Element
Project	Snake River Channel Maintenance Project
PSMP	Lower Snake River Programmatic Sediment Management Plan
RM	river mile
SEV	Severity of Effect
SRF	Snake River Fall (Chinook)
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service

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1 INTRODUCTION

This document represents the U.S. Fish and Wildlife Service's (USFWS) biological opinion (Opinion) based on our review of the U.S. Army Corps of Engineers' (Corps) proposed Snake River Channel Maintenance Project (Project), located in southeastern Washington and west central Idaho, and its effects on bull trout (*Salvelinus confluentus*) and designated bull trout critical habitat in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). The Corps' April 25, 2022, request for formal consultation on the Project was received by the USFWS on April 26, 2022. This document represents the USFWS' second tier biological opinion conducted pursuant to the USFWS' biological opinion (01EWFW00-2014-F-0660) on the Lower Snake River Programmatic Sediment Management Plan, dated November 13, 2014.

On November 13, 2014, the USFWS issued a biological opinion that represented a first tier of a programmatic consultation that addressed the framework programmatic action of adopting a programmatic sediment management plan (PSMP) to address sediment accumulation interfering with authorized Lower Snake River Projects purposes, one of which is commercial navigation. Programmatic consutlations address an agency's multiple actions on a program, regional, or other basis (50 CFR 402.02). Framework programmatic actions are those that (1) provide the framework for future, site-specific actions that are subject to section 7 consultations and incidental take statements but do not authorize, fund, or carry out those actions, and (2) do not include sufficient information to inform an assessment of where, when, and how listed species are likely to be affected (80 FR 26832).

At the broad scale, the PSMP did not authorize any action under the PSMP, but contained a set activities that may occur under the plan. In our first-tier biological opinion, we concluded that the adoption of the program would not jeopardize the continued existence of bull trout or result in the destruction or adverse modification of designated bull trout critical habitat (USFWS 2014a). The biological opinion on the PSMP determined that there was insufficient detail to quantify project-specific take at the time, but determined there was sufficient detail to determine take at the plan level and an incidental take statement was issued. The incidental take statement accompanying the first-tier biological opinion did not authorize any incidental take resulting from site-specific actions, but provided environmental surrogates for take that was reasonably expected to occur from suspended sediments and turbidity levels under a maximum dredging and disposal scenario. Under that scenario, a maximum of 500,000 cubic yards of navigation dredging and in-water disposal occurring every three years was expected to result in episodic elevated turbidity that would exceed thresholds indicating adverse physiological or behavioral effects to bull trout that comport to the regulatory definition of harm. Those conditions were expected to occur within an estimated distance of no more than 900 ft downstream and no more than 450 ft laterally, occurring for a period of up to 77 days between December 15 and March 1.

Programmatic consultation may require section 7(a)(2) analyses at both the program level and the tiered site-specific level to ensure compliance with section 7(a)(2) of the ESA (84 FR 44976). In fact, the first-tier programmatic envisioned the need for future second-tier consultation to confirm the extent of take and evaluate other site-specific effects to bull trout and designated bull trout critical habitat that could not be fully evaluated at the time. Second-tier, site-specific consultations under the PSMP are expected to confirm that predicted quantities of dredged or deposited sediment in the PSMP are not exceeded, that potential effects to the bull trout or designated bull trout critical habitat are consistent with those considered under the PSMP, and that any incidental take of the bull trout would be addressed, as appropriate.

This Opinion represents the second-tier consultation on the Corps' Snake River Channel Maintenance Project, proposed for implementation under the first-tier biological opinion. This Opinion is based on information provided in the Corps' April 25, 2022, Biological Assessment (BA: Corps 2022) for the Project, the USFWS' 2014 biological opinion on the PSMP, various telephone conversations and electronic mail correspondence with Project staff at the Corps' Walla Walla District Office, and other available sources of information, as referenced below. A complete record of this consultation is on file with the USFWS' Eastern Washington Field Office, located in Spokane, Washington.

2 CONSULTATION HISTORY

The consultation history for the USFWS' Opinion on the PSMP is incorporated herein by reference. Additional information addressing the consultation history that is specific to the proposed Project is described below.

- The Corps introduced the Project to the National Marine Fisheries Service (NMFS) and the USFWS on March 31, 2022.
- The Biological Assessment on the Project was received on April 25, 2022.
- Formal consultation on the Project was initiated on April 25, 2022.
- Additional Project information, requested via email by the USFWS on May 23, 2022, was received by the USFWS on May 24, 2022.
- Between June 8 and June 10, 2022, the USFWS requested and received additional Project information from the Corps through email.
- On June 24, 2022, the USFWS requested through email a modification to the order in which sites would dredged. The Corps agreed on June 28, 2022.
- The USFWS received additional Project information on July 5 and July 11, 2022.

3 BIOLOGICAL OPINION

4 DESCRIPTION OF THE PROPOSED ACTION

A federal action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas (50 CFR 402.02).

The Corps proposes to perform maintenance-level sediment dredging at four locations in the lower Snake River in Washington and in the lower Clearwater River in Idaho during the

2022/2023 winter period (December 15 to March 1) to meet the immediate need of providing a 14-foot-deep navigation channel, as measured at minimum operating pool (MOP). Routine channel maintenance has not occurred since winter 2014/2015, and shoaling in the navigation channel has become critical in some locations, creating a safety hazard that increases risk of groundings when channel depth is not aligned with depth on navigation charts. The Corps proposes this action under the authority of the Flood Control Act of 1952 (PL 87-874), which directs the Corps to maintain a 14-foot-deep, 250-foot-wide navigation channel in the Snake and Clearwater Rivers, with wider areas authorized under 33 U.S.C. 562 at bends and turning places to support the safe and efficient movement of vessels. The 14-foot minimum depth is required to safely pass large boats and barges.

Corps policy allows for dredging of an additional foot of overdepth to account for dredging inaccuracies and an additional 1 foot as an advance measure to reduce the frequency of dredging. As described in the BA (p. 14), overdepth dredging is a standard procedure as outlined in Engineer Regulation 1130-2-520, Project Operations – Navigation and Dredging Operations and Maintenance Policies (Corps 1996) and will result in a maximum dredging g depth of 16 ft. Channel maintenance by dredging has occurred periodically since 1961 and is an anticipated action necessary to keep the channel operating for its designated navigational uses.

The Corps also proposes issuing Regulatory (Section 404 and Section10) permits authorizing dredging at commercial ports and berths operated by local port districts or private companies in Clarkston, Washington and Lewiston, Idaho. Most of these non-federal navigation areas consist of arterial channels leading from the main federal navigation channel to the port or berth as well as those areas at the port or berth used for loading, unloading, mooring, or turning around. Typically, these facilities also need to accommodate river tugs with up to four barges in tow. Due to the decreased navigation channel footprint and location, it is now necessary to dredge access channels to connect the navigation channel to the Port of Clarkston docks. The details of the channel maintenance activities are presented in greater detail below, having have been largely excerpted from the BA (pp. 1 – 20) with modifications for clarity or to reflect additional information received by the Corps following submission of the final BA.

4.1 Dredging Locations

The proposed action consists of channel maintenance dredging in two general areas; one location in the lower Snake River below Ice Harbor Dam and at four locations in the Lower Granite Reservoir. Figure 1 identified all proposed dredging sites: (1) Ice Harbor Downstream Navigation Lock Approach (Snake River at river mile (RM) 9.5); (2) Federal navigation channel at the confluence of the Snake and Clearwater Rivers (Snake RM 138 to Clearwater RM 2.0); (3) Port of Clarkston, Washington berthing area (Snake River RM 137.9 and 139); (4) Port of Clarkston access channel (between the Port of Clarkston docks and the federal navigation channel); and (5) Port of Lewiston, Idaho berthing area (Clearwater River, RM 1 to 1.5). Dredge material will be deposited at Bishop Bar (Snake River RM 118), a suitable, mid-depth location within the Lower Granite reservoir.

The quantity of dredge material to be removed, by location, is summarized in Table 1, using survey data from 2021. The Corps anticipates needing to dredge approximately 257,910 cubic yards (cy). However, sediment is expected to continue to accumulate at each location until Project implementation. Therefore, the amount of material to be removed at the time of the dredging will likely be greater than what is shown in Table 1 but is not expected to exceed 500,000 cy (Tice, B., in litt. 2022a).

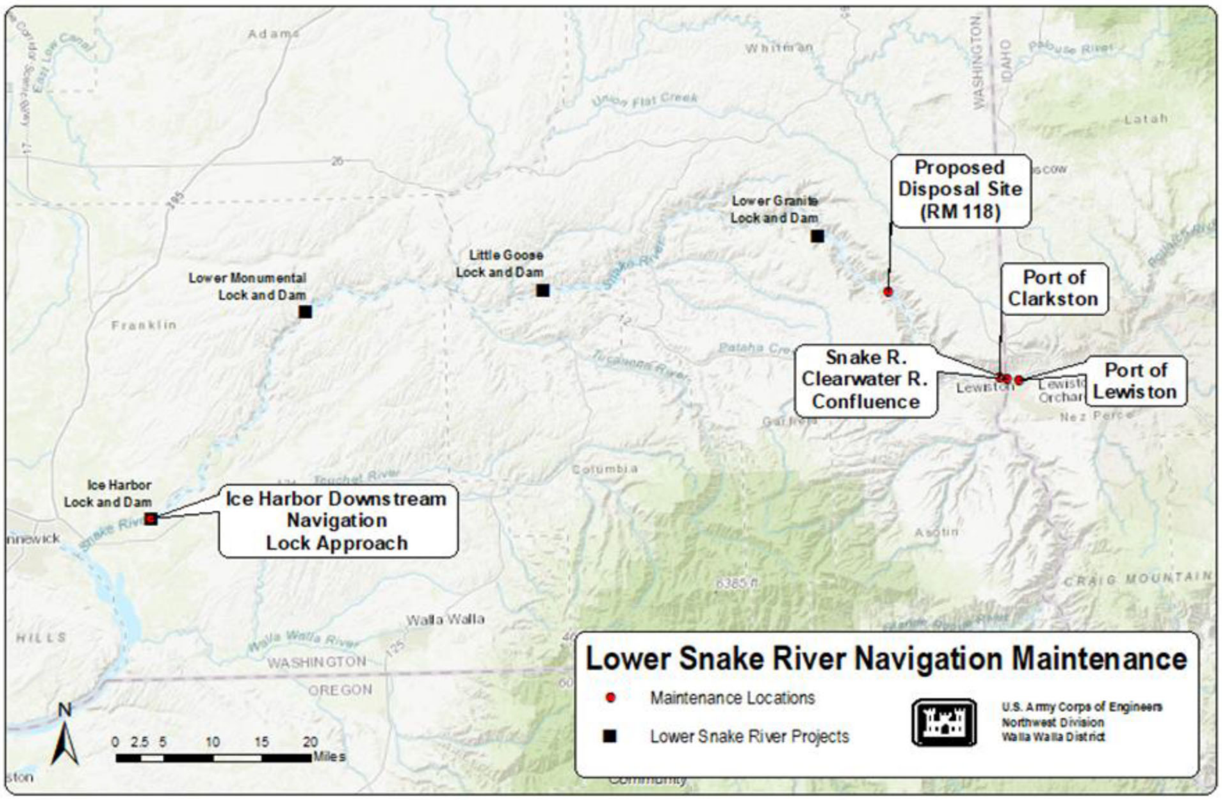

Figure 1. Map of the Proposed channel maintenance activities and dredged material disposal site (red circles). Black squares denote federal dams.
Source: Excerpted from the BA (p. 1)

Table 1. Sites proposed for immediate maintenance dredging.

Site to be Dredged	Quantity to be Dredged (cy)[1]
Federal navigation channel at confluence of Snake and Clearwater Rivers (Snake RM 138 to Clearwater RM 2)	162,040
Port of Clarkston (Snake RM 137 and 139)	21,600
Port of Clarkston Access Channels	67,740
Port of Lewiston (Clearwater RM 1-1.5)	4,380
Ice Harbor Navigation Lock Approach (Snake RM 9.5)	2,150
Total	**257,910**

[1] Based on removal to 16 ft below MOP using survey data from 2021.
Source: Excerpted from BA, p. 9

4.1.1 Ice Harbor Downstream Navigation Lock Approach

Approximately 2,150 cy of material will be removed from the Ice Harbor navigation lock approach (Figures 2 and 3) to reach a dredging depth of 16 ft below MOP. Dredging last occurred in this area in 2015. Sediment sampling in 2011 showed that sediment composition was rock substrate and cobbles greater than or equal to 2- to 6-inches. We expect the existing substrate will be similar in size.

Figure 2. Dredging location at Ice Harbor navigation lock approach.
Source: Excerpted from the BA, p. 13

Figure 3. Shoaling at Ice Harbor navigation lock approach. Areas less than 16 ft deep at Minimum Operating Pool (MOP) are in green.
Source: Excerpted from the BA, p. 14

4.1.2 Federal navigation channel at the confluence of the Snake and Clearwater Rivers

The Federal navigation channel in the Snake River refers to that portion of the Snake River inland navigation waterway maintained by the Corps. It begins at the Columbia River and Snake River confluence and includes the Ice Harbor, Lower Monumental, Little Goose, and Lower Granite locks and dams and associated reservoirs (Lake Wallula, Lake Sacajawea, Lake West, Lake Bryan, and Lower Granite Lake, respectively) on the lower Snake River and ends on the Clearwater River about a mile upstream of the Snake/Clearwater River confluence. The Corps maintains a 14-foot-deep, 250-foot-wide navigation channel through the lower Snake River reservoirs.

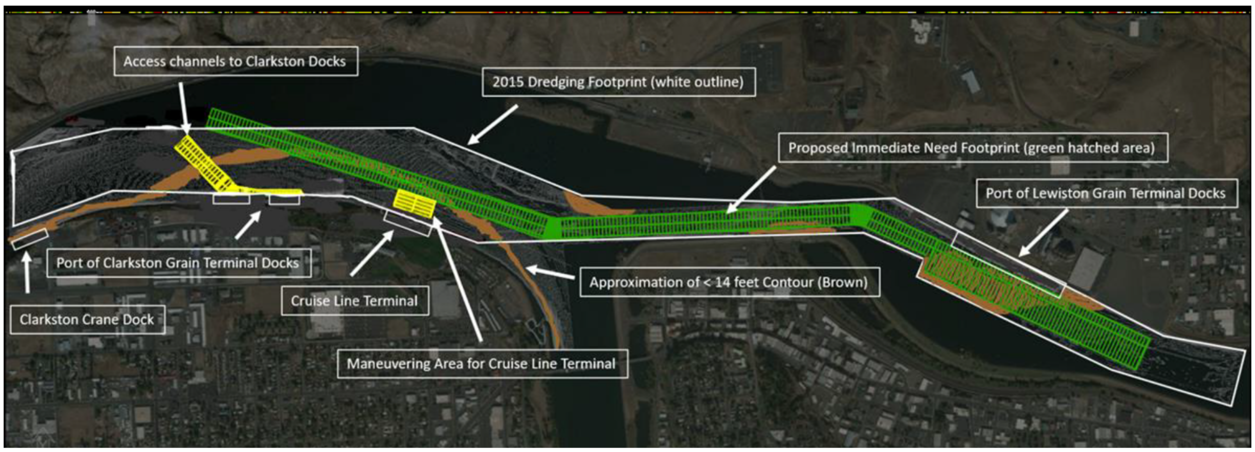

Figure 4. Federal Navigation Channel near Clarkston, Washington, and Lewiston, Idaho. The federal navigation channel is in green, the access channels to the Port of Clarkston are in yellow, and the shallow-water areas are in orange.
Source: Excerpted from the BA (p. 9)

Approximately 162,040 cy of material will be removed from the Federal navigation channel at the confluence of the Snake and Clearwater Rivers (Figure 4). Sediment, mostly sand, has been depositing in the area, primarily during spring runoff periods. Bathometric survey results from 2021 show that the area shallower than 14 ft within the proposed confluence dredging footprint at MOP has increased since 2015. Currently, the Federal navigation channel is expanded up to a maximum total width of 450 ft in front of the Lewiston Grain Terminal dock (Figure 4, right, north side of river). This widening was provided to allow for maneuvering of barge tows in accordance with navigation practice described in 33 U.S.C. § 562, which states, "Channel dimensions specified shall be understood to admit of such increase at the entrances, bends, sidings, and turning places as may be necessary to allow for the free movement of boats." Sediment samples collected in September and October 2019 from the main navigation channel in the confluence area showed the average percent sand and fines (i.e., small particles of sediment, generally silts and clays) was 96 percent and 4 percent, respectively.

4.1.3 Port of Clarkston

Non-Federal navigation areas include commercial ports and berths operated by local port districts or private companies. Most of these non-Federal navigation areas consist of side channels leading from the main Federal navigation channel to the port or berth, as well as those areas at the port or berth used for loading, unloading, and mooring. These facilities are typically designed to accommodate river tugs with up to four barges in tow. Some facilities also accommodate river tour boats carrying recreational passengers.

Approximately 21,600 cy of material will be removed from four berthing areas at the Port of Clarkston; the crane dock at the downstream end of the Port property, the grain dock, the recreation dock, and the cruise boat dock at the upstream end (Figure 5). The berthing area is defined as a zone extending approximately 50 ft out into the river from the port facilities and running the length of the port facilities. Maintenance in this area is the Port's responsibility, and the Port of Clarkston will provide funding to the Corps for this portion of the work. This area was last dredged in 2015. Sediment surveys in 2019 showed that sediment composition was primarily of 64 to 93 percent sand and 7 to 36 percent fines.

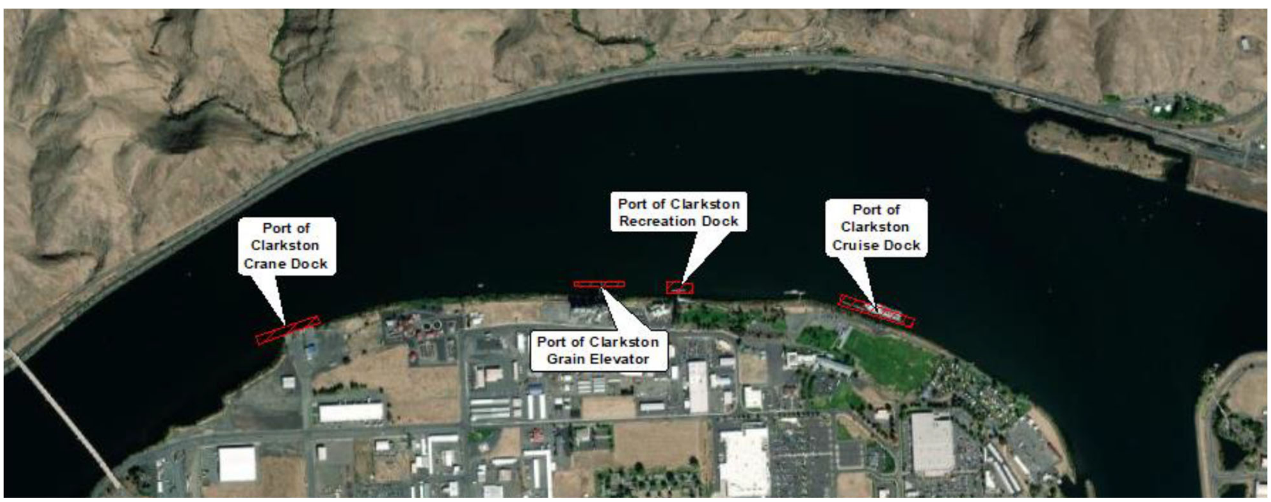

Figure 5. Port of Clarkston dredging area.
Source: Excerpted from BA (p. 11)

4.1.4 Port of Clarkston Access Channels

Due to the reduced federal navigation channel footprint, two access channels (yellow areas in Figure 4) will be dredged to connect the navigation channel to the Port of Clarkston's docks. Approximately 67,740 cy of material will be removed from the access channels.

Figure 6. Port of Lewiston dredging area.
Source: Excerpted from BA (p. 12)

4.1.5 Port of Lewiston

Approximately 4,380 cy of material will be removed from the berthing area at the Port of Lewiston (Figure 6). As in the Port of Clarkston, the berthing area is defined as a zone extending approximately 50 ft out into the river from the port facilities and running the length of the port facilities. Maintenance in this area is the port's responsibility, and the Port of Lewiston will provide funding to the Corps for this portion of the work. The area was last dredged in 2014/2015. Sediment surveys in 2019 showed that sediment composition was 97 percent sand and 3 percent fines.

4.2 Sediment Removal Methods

The Corps envisions that dredging operations will be completed using a single dredge plant, but may increase the number of dredge plants if more than one plant is necessary to complete all activities within the specified work window. As described by the Corps (Tice, B., in litt. 2022b), a dredge plant consists of a barge with crane, two tugboats, and three barges for transporting sediment to the disposal area. Dredging will be accomplished by a contractor using mechanical methods. Mechanical methods generally include clamshell, dragline, or shovel/scoop. Based on previous dredging activities, the Corps anticipates the method used will most likely be a clamshell. Material will be dredged from the river bottom and loaded onto barges for transport to the disposal site (Figure 1). Clamshell dredges with a capacity of approximately 15 cy and barges with capacity of up to 3,000 cy and maximum draft of 14 ft will be used. Sediment will be removed to a depth of up to 16 ft below MOP, consistent with the Corps policy regarding "overdepth" to account for inaccuracies in mechanical dredging methods and one foot of advance measures to reduce the frequency of dredging.

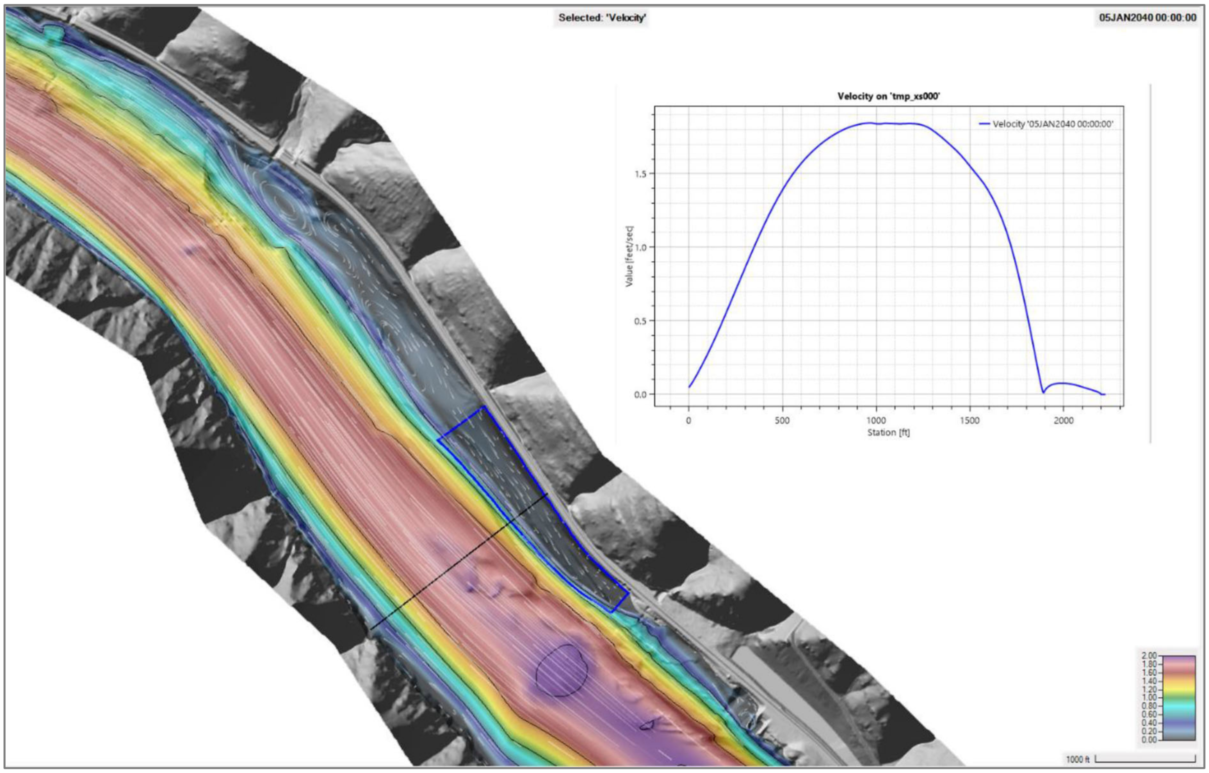

Figure 7. Velocity vector map of the proposed RM 118 disposal site at Bishop Bar (blue outline).
Source: Excerpted from the BA (p. 16)

All dredging will be performed within the established in-water work window (December 15 through March 1). Multiple-shift dredging workdays will be used when necessary to ensure that dredging is completed within the work window. The Corps assumes it will take approximately 6 to 8 hours to fill a barge, with an expected dredging rate of 3,000 to 5,000 cy per 8-hour shift. The contractor could be expected to work up to 24 hours per day and 7 days per week, if needed.

Dredged material will be loaded onto a barge, most likely a bottom-dump barge. While the barge is being loaded, the contractor will be allowed to overspill excess water from the barge, to be discharged a minimum of 2 ft below the river surface. Water quality monitoring will take place upstream, to collect background turbidity, and downstream of the dredge, as described in a monitoring plan for this project. The data will be collected near real-time so that timely measures can be taken to avoid exceeding both Washington and Idaho state water quality standards. These are the same procedures used during the previous dredging action in 2014/2015.

4.3 Disposal Site

The Corps will dispose of dredged material near Bishop Bar, at Snake RM 118 in the Lower Granite Reservoir (Figures 1 and 7). This site is located outside the Federal navigation channel and experiences lower velocities than the main thalweg. The material at the Ice Harbor navigation lock approach will be removed and disposed of first, placing the material on the bottom of the disposal area before moving the equipment up to the Clarkston and Lewiston sites. Dredging at the remaining sites will require multiple trips between the dredging sites and the disposal site. Once the barge is full of dredged material, a tugboat will push it to the disposal site. No material or water will be discharged from the barge while in transit. For in-water disposal, the barge will arrive at the disposal site and, once properly positioned, the bottom will be opened to dump the material all at once. Once unloaded, the barge will be returned to the dredging site for additional loads. While one barge is being transported to the disposal site, the contractor will continue operations, placing dredge spoils on one of the other barges.

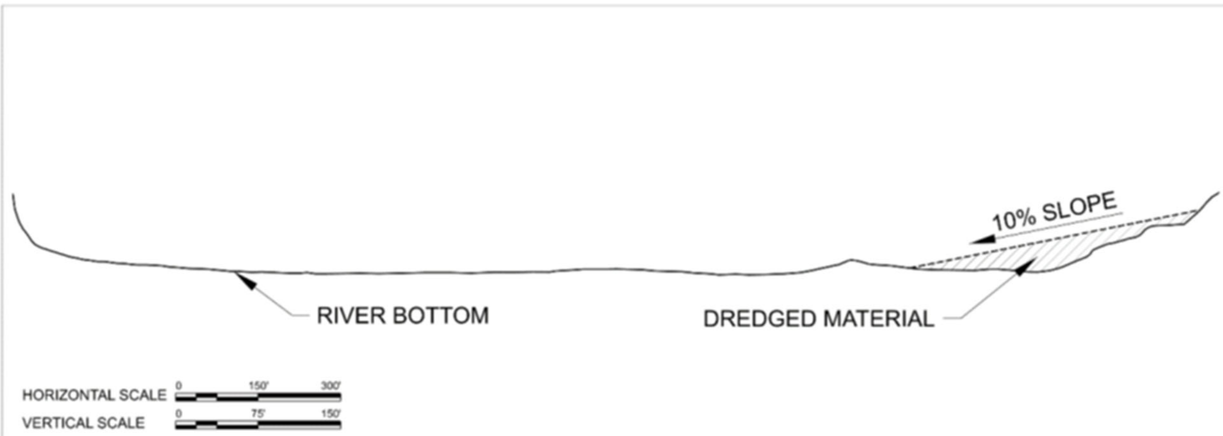

Figure 8. Cross section of disposal at Bishop Bar RM 118.
Source: Excerpted from the BA (p. 17)

The new disposal site runs approximately 2,500 ft along the shoreline and covers approximately 23 acres. Dredged material will be deposited at the downstream end first and then progress upstream. The disposal area will be sloped at 10 percent grade towards the middle of the river with the top of the disposal area being at least 20 ft below MOP (Figure 8). Due to the quantity of dredged material, there is not enough material to create shallow water habitat at this time. The Corps may use Bishop Bar for future disposal of dredge material (Tice, B., in litt. 2022c), which may eventually result in the creation of shallow water habitat. Shallow water habitat, as opposed to deeper water habitat, is defined as habitat less than or equal to 20 ft deep (Tice, B., in litt. 2022b).

4.4 Monitoring

The Corps proposes to monitor water quality, biological effects, and structural stability of the disposed material associated with the Project. This plan includes water quality monitoring that has been historically required for maintenance dredging projects in the lower Snake River as well as addressing concerns raised in previous ESA consultations. These concerns include elevated turbidity and stability of the disposal embankment. Additional monitoring requirements may be identified in the Section 401 Water Quality Certification that the Corps is requesting from the

Washington State Department of Ecology and from Idaho Department of Environmental Quality. The Corps intends to issue one or more reports presenting the results of the monitoring. All the Corps' monitoring activities described in this plan may be conducted either by the Corps or its contractors, based on the availability of funds.

Monitoring will be conducted pre-dredging, during dredging and disposal, and post-dredging and disposal. Pre-dredging includes redd surveys within the Ice Harbor navigation lock approach. In an effort to avoid disturbing or harming fall Chinook redds, the Corps will conduct underwater surveys of the proposed dredging site at the Ice Harbor navigation lock in November and the first 2 weeks of December in 2022 prior to commencing dredging. As described in the BA (p. 18), techniques similar to those used by Battelle from 1993 to 2008 (Dauble et al. 1994-1997; Mueller and Coleman 2007, 2008) will be employed. This technique has used a boat mounted underwater video camera tracking system to look at the bottom of the river to identify redds. Results of the surveys will be transferred to the Corps within 2 days of the survey dates in order for compilation prior to December 15, at which time the Corps can communicate results to NMFS for appropriate action. If no redds are located, then the Corps will proceed with proposed dredging within the boundaries of the surveyed template. If one or more redds are located within the proposed dredging template and such redds are verified with video, then the Corps will coordinate with NMFS to determine what the appropriate avoidance and protection actions should be prior to dredging the affected location.

During the dredging and disposal activities, the Corps will monitor water quality to ensure state water quality criteria are not being exceeded. Water quality monitoring will be performed before, during, and after all in-river work at each active dredging site and at the disposal site (Figure 9), consistent with monitoring efforts completed during 2014/2015 dredging. The equipment will have the capability to transmit the data via satellite or radio relay rather than having to be downloaded at each station in the field, such that several water quality parameters will be monitored in near real-time. Based on previous monitoring, turbidity was the principal parameter that was influenced by the dredging activity in the Snake River. Turbidity values measured in the field are compared to background values and action levels are defined by the states' established criteria.

The Corps' contractor will collect any observed sick, injured, or dead fish. If a sick, injured, or dead specimen is encountered, it will be placed in a container of cold river water until a biologist can be determined if it is a species listed under the ESA. If it is a listed species, the contractor will notify the Corps and the Corps will then contact the appropriate USFWS as soon as possible for further instructions. The proposed action includes language that, if a healthy fish gets entrained by the dredging operations, the Corps will make every reasonable attempt to return the specimen safely back to the river.

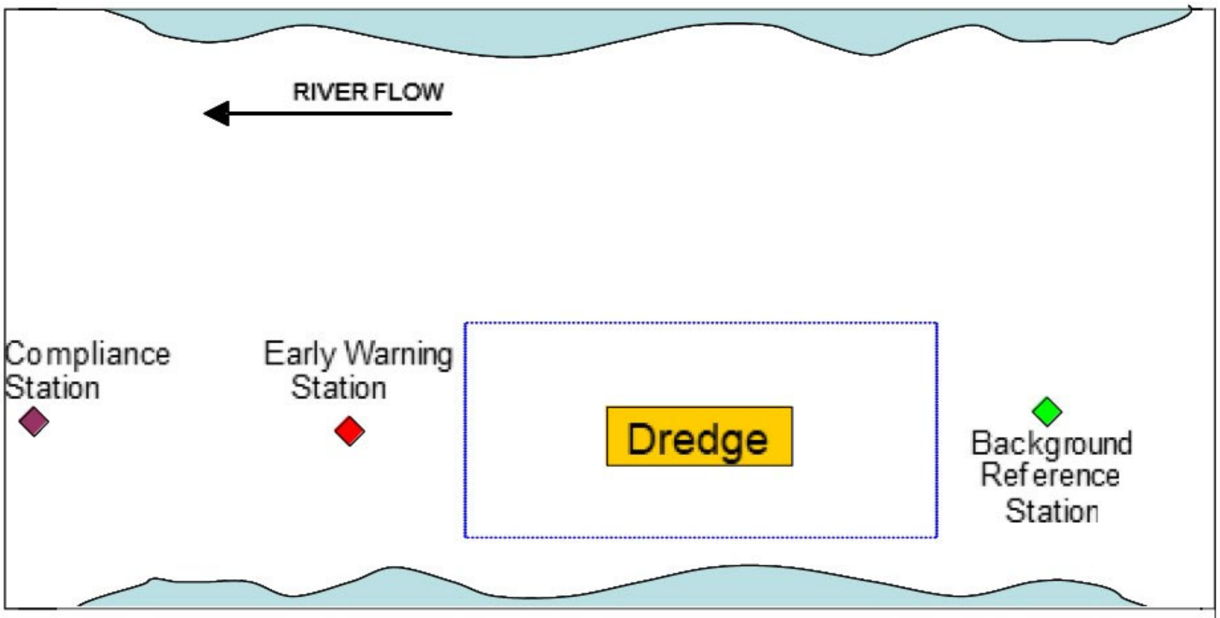

Figure 9. Conceptual schematic of water quality monitoring locations during dredging activities.
Source: Excerpted from BA (p. 18)

Post-dredging and disposal will include hydrographic surveys to ensure the disposal site is constructed as planned. The Corps will perform follow up surveys after the first spring runoff following disposal. Monitoring embankment stability will be accomplished by taking soundings soon after disposal is complete. Soundings will again be taken in the summer after high flows in order to determine if the embankment slumped or moved.

4.5 Project Timing and Sequencing

Under the proposed action, all dredging and disposal actions will occur during the winter in-water work window from December 15, 2022, to March 1, 2023. This in-water work window was established through coordination with state and Federal resource agencies as the time period in which in-water work could be performed with the least impact to ESA-listed salmonid stocks.

Dredging will occur first at the Ice Harbor site, working upstream to each subsequent dredging site. In response to the sediment montoring results that showed screening level exceedances at the Port of Clarkston location, the Corps has agreed to depositing material from the Port of Clarkston at Bishop Bar prior to depositing material from the Port of Lewiston, which will act as a cap to the Clarkston material (Tice, B., in litt. 2022d). At the disposal site, the dredged material will be placed in steps. The first step will be to place the cobbles from the Ice Harbor lock approach along the outer edge of the planned footprint. This will be followed by placing a mixture of the silt and sand to fill the mid-depth portion of a site and form a base embankment. The dredged material will be transported by barge to the disposal area, where the material will be placed within the designated footprint. This footprint will be close to the shoreline, so that the river bottom could be raised to create an underwater shelf about 20 ft below MOP.

Per the BA (p. 20), the proposed action would allow operations of Lower Granite dam to return to MOP, from the current MOP+3 operation, during the desired time identified in the NOAA Columbia River System Biological Opinion (NMFS 2020) during the juvenile salmon outmigration season, but possibly not indefinitely as sediment is expected to continue to deposit/accumulate. No other operational changes to the system are expected, unless operation above MOP again becomes necessary to support authorized project purposes (e.g., navigation).

4.6 Conservation Measures

The Proposed Action includes a number of proposed conservation measures intended to minimize or avoid environmental impacts to listed species or designated critical habitat and are incorporated into the initial Project design as a proactive means for avoiding or minimizing adverse impacts associated with Project activities. Additionally, the Corps has committed to implementing those conservation measures identified under the PSMP that are appropriate to this second-tier consultation (Tice, B., in litt. 2022c). Conservation measures from the PSMP are included in this section, as well.

4.6.1 Proposed Conservation Measures identified in the BA

The following conservation measures were largely excerpted from the BA (pp. 20-21).

1. Dredging activities may commence no earlier than December 15, and conclude not later than March 1, unless extending the dates are necessary for completing the channel maintenance and NMFS and USFWS concur that the change will remain within the scope of the consultation.

2. Equipment will be inspected for oil/fluid leaks and cleaned prior to working. Any detected leaks will be repaired before the work begins.

3. A spill prevention and control plan will be developed and discussed with equipment operating personnel prior to work.

4. A survey for redds will occur below the Ice Harbor navigation lock prior to dredging. If Chinook salmon redds are discovered, the Corps will notify NMFS. The two agencies will jointly determine the appropriate course of action.

5. The Corps will dispose of Port of Clarkston dredge spoils at Bishop Bar and cover them with dredge spoils from Port of Lewiston, forming a cap as a precautionary measure to reduce potential redistribution of sediments that exceed screening thresholds.

6. Water quality monitoring will be conducted at the dredging and disposal sites in near real-time so that operational changes can occur rapidly if water quality standards are exceeded.

7. Dredging activities will be concluded in a single in-water work period.

Typical types of best management practices will depend on site-specific conditions but will generally include the following.

1. The Corps will perform monitoring as described in section 4.4, *Monitoring,* of this Opinion.

2. In-water disposal will only occur at the proposed RM 118 disposal site.

3. If the Corps or its contractor discovers that a threatened or endangered species has been entrained by dredging operations, every reasonable attempt will be made to return the specimen safely back to the river. If a sick, injured, or dead specimen of a threatened or endangered species is observed, the finder must notify the Corps Contracting Officer or representative immediately, who will then contact NMFS or the USFWS, as appropriate.

There is no mitigation required under other permits at this time and the Corps is not proposing any compensatory mitigation to offset any unavoidable effects. The Corps intent is to return the operation of Lower Granite Reservoir back to at or near the minimum operating pool elevation to provide potential fish passage benefits for downstream migrating juvenile salmonids, subject to future sediment deposition/accumulation. However, the Corps has committed, subject to their authority and funding, to further investigate and pursue opportunities to enhance shallow-water rearing habitat.

4.6.2 Proposed Conservation Measures identified in the PSMP

The following conservation measures were excerpted from the PSMP BO (USFWS 2014a, pp. 23-25). Only those measures consistent with the Proposed Action are included here.

4.6.2.1 General

- The Corps will observe appropriate in-water work windows. In-water work would be conducted during the winter window of December 15 to March 1.
- The Corps will comply with applicable State water quality standards.
- The Corps will comply with applicable site/action-specific conservation measures when implementing subsequent actions.

Conservation measures associated with minimization of identified effects of the action include:

4.6.2.2 Dredging

- Sediment sampling – The Corps will perform sediment sampling and analysis prior to dredging as required by applicable regional agreements such as the 2009 *Sediment Evaluation Framework for the Pacific Northwest, the 2013 Dredged Material Evaluation and Disposal Procedures User Manual, or any subsequent revisions or successors to these documents.*
- Mechanical dredging will be used for mainstem actions and either mechanical or hydraulic dredging will be used in backwater areas.

- Employ an experienced equipment operator.
- The Corps' contractor will monitor for sick, injured, or dead fish. They will visually monitor the waters surrounding the dredging and disposal activities as well as observing the content of each clamshell bucket as it discharges in the barges. If a sick, injured, or dead specimen is encountered, it will be placed in a container of cold river water until it can be determined if it is a species listed under the ESA. If it is a listed species, the contractor will notify the Corps and the Corps will then contact the appropriate USFWS as soon as possible for further instructions. If a healthy fish gets entrained by the dredging operations, the Corps will make every reasonable attempt to return the specimen safely back to the river.

4.6.2.3 Turbidity

The Corps will implement a number of techniques to minimize turbidity effects resulting from project operations.

- The Corps will monitor turbidity levels and modify dredging operations to avoid prolonged negative effects.
- If water standards for turbidity are exceeded the Corps will employ one or more of the following bucket control best management practices (BMPs):
    - No reopening to fill a partially filled bucket.
    - Do not overfill the bucket.
    - Close the bucket as slowly as possible on the bottom.
    - Pause before hoisting the bucket off the bottom to allow any overage to settle near the bottom.
    - Hoist load very slowly.
    - Pause bucket at water surface to minimize distance of discharge.
    - "Slam" open the bucket after material is dumped to dislodge any additional material that is potentially clinging to the bucket.
    - Ensure that all material has been dumped from the bucket before returning for another bite.
    - Do not dump partial or full buckets of material back into the waterway.
    - Vary the volume, speed, or both of digging passes to minimize siltation to the maximum extent practicable.

4.6.2.4 Snake River Fall Chinook Redds

- To prevent disturbance or harm to potential Snake River Fall (SRF) Chinook redds when dredging in an area that might have redds, the Corps will conduct underwater surveys of the proposed dredging site and within 900 ft downstream of the navigation locks when dredging below the dams, once in November and once during the first two weeks of December prior to commencing dredging. Techniques similar to those used by Battelle from 1993 to 2008 will be employed (Dauble et al. 1996; Dauble et al. 1994; Dauble and

Watson 1997; Mueller and Coleman 2007; Mueller and Coleman 2008). This technique has used a combination of a boat mounted underwater video camera tracking system to look at the bottom of the river to identify redds. The Corps will compile the results prior to December 15, at which time the Corps can communicate results to NMFS for appropriate action.

- If no redds are located, then the Corps will proceed with proposed dredging within the boundaries of the surveyed template.
- If one or more redds are located within the proposed dredging template and such redds are verified with video, then the Corps will coordinate with NMFS to determine if dredging can proceed without harming or disturbing the redd(s) or needs to be delayed until fry are able to move out of the area.

4.6.2.5 Spills

- All over-water construction vessels will be fueled at existing commercial fuel docks. Such facilities have existing spill prevention systems in place that would be adequate to avoid spills or immediately address any accidental spills that might occur.
- Equipment will be inspected and cleaned prior to any instream work.

4.6.2.6 Suspension of Chemicals of Concern

- Conduct dredging and disposal when listed salmonids are least likely to be in the work area.
- The Corps will not use in-water disposal/placement for any material that is not determined to be suitable for in-water placement in accordance with the *2009 Sediment Evaluation Framework for the Pacific Northwest, the 2013 Dredged Material Evaluation and Disposal Procedures User Manual*, or any subsequent revisions or successors to these documents.
- Use BMPs to prevent spills of fuel, or hydraulic leaks during the dredging and disposal operation.
- The Corps will use BMPs at disposal locations to prevent remobilization of sediments, and subsequent turbidity, through dewatering activities or storage.

4.6.2.7 Entrainment

- Dredging activities at locations and times of the year when ESA-listed fish would likely be present (e.g., the mainstem of the Snake and Clearwater rivers) will be accomplished using mechanical means which are slow enough to frighten fish and give them time to move away.

4.7 Consistency with the Programmatic Sediment Management Plan

As previously described, the Proposed Action represents a second tier, site-specific consultation, under the 2014 PSMP. Second-tier, site-specific consultations under the PSMP are expected to confirm that predicted quantities of dredged or deposited sediment in the PSMP are not exceeded, that potential effects to bull trout or designated bull trout critical habitat are consistent with those considered under the PSMP, and that any incidental take of bull trout would be addressed, as appropriate. This evaluation is intended to confirm the Proposed Action is consistent with the activities described in the PSMP and addresses all Terms and Conditions described in the Incidental Take Statement accompanying the PSMP BO.

The USFWS' programmatic biological opinion on the PSMP (USFWS 2014a) describes: (1) a range of management measures that would be undertaken to address sediment issues, (2) areas where sediment issues are likely to recur, (3) the framework for identifying actions to respond to specific sediment issues, (4) conservation measures to be implemented when sediment management actions are taken, and (5) the potential frequency, duration, and magnitude of specific actions. The USFWS has evaluated each project element of the PSMP and determined that the proposed action is largely consistent with the PSMP (Table 2).

Table 2. Dredging elements identified in the PSMP compared to the Proposed Action.

	PSMP, Activity Type: Navigation Dredging	**Proposed Action**	**Consistent with PSMP (Yes/No)**
Quantity of Sediment Dredged, cy per event	6,000-7,200 cy/day total quantities up to 500,000 cy	Approximately 257, 910 cy total [a] 6,000 to 7,200 cy/day[b]	Yes
Quantity of in-water disposal	6,000 to 7,200 cy/day	6,000 to 7,200 cy/day	Yes
Dredging locations	Snake River RM 0 to 139; Clearwater River RM 0 to 2	Snake River RM 9.5, 137 to 139; Clearwater River RM 1 to 2	Yes
Disposal of Dredge Material	In-water or upland; Beneficial Use (e.g., shallow water habitat)	In-water; medium depth habitat (non-beneficial)	No
Timing	Dec 15 to Mar 1	Dec 15 to Mar 1	Yes
Duration	77[c] days	77 days	Yes
Dredging Frequency	Every 3 to 5 years	8 years (last dredged in winter 2014/2015)	Yes

[a] Sediment quantity may be greater due to accumulation since monitoring last occurred but is not expected to exceed 500,000 cy total (Tice, B., in litt. 2022a).
[b] Removal of 257,910 cy of sediment would require approximately 3,350 cy per day removal, but Project-related sediment removal rates approximating the PSMP (Tice, B., in litt. 2022a).
[c] The PSMP identifies 75 days, but the work window duration, spanning 77 days, is listed here.

The proposed action will address sediment issues, at sites where sediment accumulation historically has affected authorized purposes or sediment accumulation may potentially be a problem in the future, through dredging and dredged materials management, disposing of dredged materials in-water and in accordance with Corps regulations (33 CFR 335-338) to identify and utilize the lowest cost, least environmentally damaging, practicable alternative. Through the PSMP (USFWS 2014a, p. 26), the Corps anticipates dredging 200,000 to 500,000 cy of material, primarily from the Snake and Clearwater Rivers confluence area, every 3 to 5 years (Table 2) to meet navigational needs, unless longer-term solutions are identified. This is consistent with the Proposed Action that anticipates 257,910 cy of sediment dredging and disposal but clarifies that additional sediment accumulation since the 2021 monitoring event will also be subject to dredging and removal; hence, the quantity identified in the BA is considered a minimum dredge quantity. The final dredge quantity is not known at this time but is not expected to exceed 500,000 cy (Tice, B., in litt. 2022a). Although the BA (p. 15) indicates daily sediment removal of 9,000 to 15,000 cy per day (3,000 to 5,000 cy per 8-hour shift and operations occurring 24-hours per day), further clarification from the Corps anticipates daily removal to average approximately 6,000 to 7,200 cy (Tice, B., in litt. 2022a).

Per the PSMP (USFWS 2014a, p. 11), opportunities for beneficial use are identified and evaluated as part of the planning of any dredging activity. Previously, the Corps has beneficially used dredged material to create shallow water fish habitat in the lower Snake River. Under the proposed action the dredged sediment will be used to construct a uniform, sand-dominated substrate, sloping (approximately 10 percent), mid-depth (between 20 and 60 ft) habitat resembling a sand bar with features optimized for resting/rearing of outmigrating juvenile salmonids, and targeted towards SRF Chinook salmon production (BA, p. 65), located at Bishop Bar (Figure 1). The site is located outside of the Federal navigation channel, and experiences lower velocities than the main thalweg. In contrast to the PSMP beneficial use component, the quantity of dredged material identified in the proposed action is insufficient to create shallow water habitat at the disposal location. With subsequent dredging efforts, the Bishop Bar disposal site could be added to, and shallow water habitat could be created. Through their conservation measures, the Corps has committed to investigate and pursue opportunities to enhance shallow water rearing habitat within their authority and funding (BA, p. 20).

Reasonable and Prudent Measures and their associated Terms and Conditions are described in the PSMP BO (pp. 85 – 86) and include (1) initiating site-specific consultation with the USFWS prior to Project implementation to obtain an incidental take permit; (2) perform sediment sampling and screening and use the data to develop a disposal plan that minimizes effects from resuspension of contaminants; (3) perform water quality monitoring; (4) prepare a report for the USFWS describing Project-specific activities; (5) cease dredging if the quantity dredged exceeds the maximum allowable under the PSMP; (6) comply with state water quality standards; and (7) prevent disposal of contaminated sediments. Many of these measures are incorporated into the proposed action and are considered under this site-specific consultation.

The USFWS has evaluated the Proposed Action for consistency with the PSMP and has determined that the action is substantively consistent with the PSMP. The Proposed Action deviates somewhat from the PSMP in the beneficial use of dredged material because, despite the fact that the final quantity of dredge material is currently unknown, the Corps anticipates insufficient quantity to create shallow-water habitat. Use of dredge materials to create in-water beneficial habitat is one of many intended uses of dredged material envisioned under the PSMP. As described in the BA (pp. 65-66), shallow water habitat created through the program primarily benefits SRF Chinook, but also has the potential to indirectly benefit bull trout through improvements to preybase and prey habitat (USFWS 2014a, p. 50). Through the analysis in the

PSMP BO (USFWS 2014a, p. 70), the USFWS concluded that bull trout may benefit from the creation of shallow water habitat and that site-specific effects to bull trout foraging habitat and prey base would be analyzed during the second-tier, site-specific consultation.

5 ACTION AREA

The Action Area is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the Action Area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on these environments. The Action Area for this proposed federal action is based on the geographic extent of underwater sound and sediment transport.

The proposed action includes dredging across approximately 100 acres of river bottom and disposal of dredged material across approximately 23 acres (BA, p. 15). Project implementation is expected to result in elevated underwater noise, attenuating with distance from source, and sediment transport a short distance downstream of the activities. Additionally, project sequencing includes transport along the lower Snake River corridor as barges and equipment are moved from Ice Harbor Dam (approximately Snake RM 9.5) upstream to the Clearwater River at Lewiston, Idaho (approximately Clearwater RM 1.2). In total, the proposed action will cover over 130 miles, with most work occurring between Snake RM 118, at Bishop Bar, to Snake RM 139, at the confluence of the Snake and Clearwater Rivers (BA, p. 15).

At the Ice Harbor Dam approach, the substrate is dominated by gravel and cobble greater than 2 to 6 inches in diameter, mostly free of fines (BA, p. 70). Based on previous monitoring (BA, p. 71), we do not expect significant amount of fines to be transported downstream of this site. Therefore, we find the extent of underwater noise is a more appropriate basis for determining the extent of the downstream Action Area. Underwater noise associated with dredging is expected to occur with greatest intensity where the dredging bucket contacts the substrate. Through our previous analysis (USFWS 2014a, p. 65), we have determined that underwater sound pressure levels may be in the range of 112 to 160 dB at the site of dredging. Assuming 160 dB at 1-meter from dredging and transmission loss of underwater noise (i.e., attenuation) of 4.5 dB per doubling of distance (WSDOT 2020, p. 7.32), we anticipate that ambient noise levels (106 dB) will be reached within approximately 4,096 meters, or approximately 2.5 miles downstream, assuming open water conditions. This is a very conservative estimate, as sound transmission is affected by bottom topography, flow, water level, sediment type and the presence of underwater structures. Transmission is also restricted by the presence of surrounding landforms; thus, underwater sound transmission is limited to the furthest straight-line distance (i.e., "line-of-sight") and will not extend beyond the nearest riverbanks and will be interrupted by existing islands located downstream of the dam.

At the Lower Granite Reservoir sites, the high percentage of fine materials in the substrate is expected to result in lower levels of underwater sound pressure levels when the dredging bucket contacts the substrate. Project-related noise from equipment operations will likely be similar to ambient noise that exceeds natural background levels due to the developed nature of the Port areas that already experience relatively high levels of commercial barge and recreational boating traffic. We expect Project-related noise to be largely masked by or similar to these baseline levels. Thus, we have determined that sediment transport is a more appropriate basis for determining the upper extent of the Action Area. We do not expect turbidity plumes to extend very far upstream of Project operations because the Clearwater River displays riverine characteristics at the most upstream site (Figure 4) on the Clearwater River. The Corps is committed to monitoring the operation throughout the dredging operations, allowing them to respond in almost real time to increases in sediment and turbidity, and the extent of the turbidity plume is expected to adhere to the Washington State Water Quality Guidelines to remain within water quality standards outside of 300 ft from operations. Turbidity plumes may extend to a lateral distance of 450 ft laterally within the river channel (Schroeder 2014, *in* USFWS 2014a, p. 58). Therefore, the upper end of the Action Area is bound by the extent of Project-related sediment, or the upstream end of project operations and laterally extended to 450 ft.

6 ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

6.1 Jeopardy Determination

The following analysis relies on four components: (1) the Status of the Species, which evaluates the rangewide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the species in the Action Area, the factors responsible for that condition, and the relationship of the Action Area to the survival and recovery of the species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the species; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the Action Area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the consequences of the proposed Federal action in the context of the species' current range-wide status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild. The key to making this finding is clearly establishing the role of the Action Area in the conservation of the species as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role.

NOTE: If recovery units were defined in the final listing rule for use in completing jeopardy analyses, pursuant to USFWS policy, when an action impairs or precludes the capacity of a recovery unit from providing both the survival and recovery function assigned to it, that action may represent jeopardy to the species. When using this type of analysis, the Biological Opinion describes how the consequences of the proposed Federal action on the listed species, taken together with cumulative effects, affect the capability of the recovery unit to support both the survival and recovery of the species as a whole.

6.2 Adverse Modification Determination

Section 7(a)(2) of the ESA requires that federal agencies ensure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of “destruction or adverse modification of critical habitat” was published on February 11, 2016 (81 FR 7214). The final rule became effective on March 14, 2016. The revised definition states: “Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.”

Designations of critical habitat prior to February 11, 2016 used the terms "primary constituent elements" (PCEs), "physical or biological features" (PBFs) or "essential features" to characterize the key components of critical habitat that provide for the conservation of the listed species. The 2016 critical habitat regulations (81 FR 7414) discontinue use of the terms “PCEs” or “essential features,” and rely exclusively on use of the term “PBFs” for that purpose because that term is contained in the statute. However, the shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. For those reasons, in this Opinion, references to PCEs or essential features should be viewed as synonymous with PBFs. All of these terms characterize the key components of critical habitat that provide for the conservation of the listed species.

Our analysis for destruction or adverse modification of critical habitat relies on the following four components: (1) the Status of Critical Habitat, which evaluates the range-wide condition of designated critical habitat for the bull trout in terms of essential features, PCEs, or PBFs, depending on which of these terms was relied upon in the designation, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the Environmental Baseline, which evaluates the condition of the critical habitat in the Action Area, the factors responsible for that condition, and the recovery role of the critical habitat in the Action Area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the essential features, PCEs, or PBFs and how those effects are likely to influence the recovery role of affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the Action Area on the essential features, PCEs, or PBFs and how those effects are likely to influence the recovery role of affected critical habitat units.

For purposes of making the destruction or adverse modification finding, the effects of the proposed federal action, together with any cumulative effects, are evaluated to determine if the critical habitat rangewide would remain functional (or retain the current ability for the PBFs to be functionally re-established in areas of currently unsuitable but capable habitat) to serve its intended conservation/recovery role for the bull trout.

7 STATUS OF THE SPECIES: Bull Trout

The bull trout was listed as a threatened species in the coterminous United States in 1999. Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alteration (associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, and poor water quality), incidental angler harvest, entrainment, and introduced non-native species (64 FR 58910 [Nov. 1, 1999]). Since the listing of bull trout, there has been very little change in the general distribution of bull trout in the coterminous United States, and we are not aware that any known, occupied bull trout Core Areas have been extirpated (USFWS 2015b, p. iii).

Since the completion of the PSMP BO, the USFWS completed a bull trout recovery plan. The 2015 recovery plan for bull trout identifies six recovery units of bull trout within the listed range of the species (USFWS 2015b, p. 34). Each of the six recovery units are further organized into multiple bull trout Core Areas, which are mapped as non-overlapping watershed-based polygons, and each Core Area includes one or more local populations. Within the coterminous United States, we currently recognize 109 currently occupied bull trout Core Areas, which comprise 600 or more local populations (USFWS 2015b, p. 34). Core areas are functionally similar to bull trout meta-populations, in that bull trout within a Core Area are much more likely to interact, both spatially and temporally, than are bull trout from separate Core Areas.

The USFWS has also identified a number of marine or main-stem riverine habitat areas outside of bull trout Core Areas that provide foraging, migration, and overwintering (FMO) habitat that may be shared by bull trout originating from multiple Core Areas. These shared FMO areas support the viability of bull trout populations by contributing to successful overwintering survival and dispersal among Core Areas (USFWS 2015b, p. 35). The proposed project will occur within the lower Snake River, and Snake and Clearwater Rivers confluence area shared FMO habitats.

For a detailed account of bull trout biology, life history, threats, demography, and conservation needs, refer to Appendix A: Status of the Species: bull trout.

8 STATUS OF DESIGNATED CRITICAL HABITAT: Bull Trout

Bull trout critical habitat was designated in the coterminous United States in 2010 and has not been updated since the completion of the PSMP BO. The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas. Overall bull trout abundance is "stable" range-wide (USFWS 2015b, p.iii). However, 81 Core Areas have 1,000 or fewer adults, with 24 Core Areas not having surveys conducted to determine adult abundance (USFWS 2008a, p. 22; USFWS 2015a, p. 2). In addition, 23 Core Areas have declining populations, with 66 Core Areas having insufficient information (USFWS 2008a, p. 22; USFWS 2015a, p. 2). These values reflect the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10, 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat and continue to do so. Among the many factors that contribute to degraded PCEs, those that appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows:

1. fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652, Rieman and McIntyre 1993, p. 7);

2. degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; The Montana Bull Trout Scientific Group (MBTSG) 1998, pp. ii-v, 20-45).

3. the introduction and spread of nonnative fish species, particularly brook trout (*S. fontinalis*) and lake trout (*S. namaycush*), as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993; Rieman et al. 2006);

4. in the Puget Sound and Olympic Peninsula geographic regions where anadromous bull trout occur, degradation of main-stem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and

5. degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

For a detailed account of the status of the designated bull trout critical habitat, refer to Appendix B: Status of Designated Critical Habitat: bull trout.

9 ENVIRONMENTAL BASELINE: Bull Trout and Designated Bull Trout Critical Habitat

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all federal, state, or private actions and other human activities in 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 section 7 consultation, and the impacts of state and private actions which are contemporaneous with the consultation in progress.

Many of the factors influencing the status of bull trout and its designated critical habitat that were described in the USFWS' 2014 PSMP BO continue to impact both bull trout and its designated critical habitat to this day; thus, the contents of the PSMP BO, including the description of the Environmental Baseline, is incorporated by reference. Ongoing impacts that continue to impact bull trout and its critical habitat are summarized in this section and updated where new information has become available. Through this effort, we are updating our understanding of the numbers and distribution of bull trout in the Action Area, as well as the status of bull trout in Core Areas from which bull trout in the Action Area originate. The USFWS recently updated the current condition of bull trout in the mid-Columbia, lower Snake and Clearwater Rivers through its biological opinion on the operations and maintenance of the Columbia River System in Washington, Oregon, Idaho, and Montana (CRS Opinon: USFWS

2020). This section largely relies on information presented in the CRS Opinion to update our understanding of the environmental baseline for bull trout and designated bull trout critical habitat in the Action Area.

The proposed project will occur within the Mid-Columbia Recovery Unit (MCRU), overlapping two shared FMO habitats; the Snake River and the Clearwater River. Shared FMO habitats are defined as relatively large streams and mainstem rivers, including lakes or reservoirs, estuaries, and nearshore environments, where subadult and adult migratory bull trout forage, migrate, mature, or overwinter (USFWS 2015b, p. C-2). The Action Area has been defined as the area of the lower mainstem Snake River from the downstream approach at Ice Harbor Dam at approximately Snake RM 9.5 upstream to the confluence of the Snake and Clearwater Rivers and continuing upstream of Lewiston, Idaho, at approximately Clearwater RM 2. The Action Area is located within designated bull trout critical habitat, and bull trout currently utilize the Action Area for foraging and subadult rearing, overwintering, and migration.

9.1 Status of Bull Trout in the Action Area

Within the broader region encompassing the Action Area, foraging, migration, and over-wintering habitats for bull trout primarily occur in the mainstems of the Snake, Clearwater, and Columbia Rivers and in the middle to lower reaches of major tributaries to these rivers, while spawning and rearing habitats occur in the extreme upper reaches of the major tributaries (USFWS 2002a, pp. 10-16). The Action Area encompasses approximately 130 miles of the mainstem of the lower Snake River and approximately 2 miles of the mainstem of the lower Clearwater River just above its confluence with the Snake River. There are no defined Core Areas or local populations of bull trout within the Action Area. Any foraging, migrating, or over-wintering bull trout that occur within the Action Area represent adult or subadult bull trout that have moved into these shared areas but that originate from, or potentially interact with, various Core Areas found within major tributaries of the Mid-Columbia, Snake, and Clearwater Rivers. Spawning and rearing occurs in a subset of tributaries connected to these Core Areas, but does not occur in the mainstem Snake or Clearwater Rivers.

In our 2014 PSMP BO, we determined that bull trout from the Walla Walla River, Tucannon River, and Asotin Creek Core Areas, as well as bull trout from the Core Areas of the Clearwater River may occur in the Action Area. Through various lines of evidence, such as PIT-tagging and genetics, we have updated our understanding of bull trout movement in the lower Snake and Clearwater Rivers, and have determined that bull trout from the following Core Areas may be present in the Action Area: Walla Walla River, Wenatchee River, Entiat River, Tucannon River, Asotin Creek, Grande Ronde River, Imnaha River, North Fork Clearwater River, South Fork Clearwater River, Selway River, and Lochsa River. Due to the fact that migratory bull trout that occur in the Action Area spend a portion of their lives outside of the Action Area, habitat conditions and threats experienced within Core Areas influence the number of bull trout that may be present in the Action Area. Table 3 summarizes expected bull trout presence/use of the Action Area and the general status of each Core Area. For a discussion of the status of bull trout within each of these Core Areas that influence the occurrence and density of bull trout in the Action Area, refer to Appendix C: Status Of Bull Trout in Core Areas Associated with the Action Area.

Table 3. Summary of Baseline Conditions for bull trout by Core Area within the Action Area.

Core Area	# of Local Populations	Status (Stable/ Depressed)	Presence/Use of Action Area
Walla Walla	3	Depressed	Documented movements to Columbia River year-round, peaking in September through February. Documented passage at two lower Snake River dams.
Wenatchee	7	Stable	Regular year-round use of mainstem Columbia River. No documented use of Snake River; however a small percentage is estimated to migrate long distances, including into other Core Areas.
Entiat	2	Depressed	As much as 90 percent of the population uses the mainstem Columbia River for FMO. No documented use of Snake River; however, bull trout of unknown origin documented passing lower Snake River dams could include Entiat fish.
Tucannon	5	Depressed	Regular use of the Snake River, presence expected year-round at unknown quantities. Documented passage at all four lower Snake River dams.
Asotin	1	Depressed	Documented movement to Snake River at low numbers, due to small population size.
Grande Ronde (4 Core Areas)	17	Stable	No documented use of Snake River; however, 7 of 17 local populations support migratory life histories that may use Action Area at low numbers.
Imnaha	8	Stable	Regular year-round use of Snake River upstream of Action Area. Estimates of 800 to 1200 individuals from Basin in Snake River per year. Documented presence in Lower Granite Reservoir; may be present at low numbers.
NF Clearwater	12	Stable	Low levels of entrainment into mainstem Clearwater River below Dworshak Dam documented. No migratory barriers to downstream movement into the Snake River; may be present at low numbers.
SF Clearwater	5	Stable	Likely seasonal migratory use of mainstem Clearwater River below Dworshak Dam at unknown levels. No migratory barriers to downstream movement into the Snake River; may be present at low numbers.
Selway	10	Stable	Likely seasonal migratory use of mainstem Clearwater River below Dworshak Dam at unknown levels. No migratory barriers and documented connectivity to lower Snake River; may be present at low numbers.
Lochsa	17	Stable	Likely seasonal migratory use of mainstem Clearwater River below Dworshak Dam at unknown levels. No migratory barriers and documented connectivity to lower Snake River; may be present at low numbers.

Adapted from USFWS 2020 (pp. 184-185).

Bull trout use of the lower Snake River has been documented from observations in the fish ladders, PIT tag arrays at fish ladders and juvenile bypass systems at dams and arrays in various tributaries, various research projects, and through anecdotal accounts (Barrows et al. 2016). In many cases, it is unknown from which populations or Core Areas these bull trout originate (Table 4), so total observations at Snake River Dams are summarized below (Table 5 and Table

6). Bull trout have been documented at all lower Snake River dams and facilities, but the exact number of bull trout at each facilities remains unknown. It is likely the numbers below are low in relation to total numbers of bull trout present in the lower Snake River.

The Corps regularly conducts fish counts at passage facilities on all four of the lower Snake River dams to monitor various salmonid populations (Tables 5 and 6), but the salmonid monitoring program focuses on timing and runs for anadromous fish and was not developed to address bull trout. This anadromous fish monitoring does not continue throughout the year, notably excluding most winter months when overwintering bull trout would be expected to occur in the mainstem. Fish ladder counts from 2006 to 2013 (Table 5), provided in the PSMP BO, exclude monitoring from December through February when overwintering bull trout would be expected to occur in the mainstem. Therefore, those numbers should be viewed with caution as individual fish were not marked and may have been counted more than once.

Table 4. Total bull trout PIT tag detections at Columbia River Systems dams from 2006 – August 2021.

Dam	**Total # detected (range per year)[a]**	**Size Range at tagging (mm)**	**Watershed tagged, if known**
McNary	6 (0 - 3)	144 - 314	25% Tucannon River 75% Walla Walla River
Ice Harbor	4 (0 - 2)	233 - 234	100% Tucannon River
Lower Monumental	12 (0 - 4)	234 - 370	22% Unknown origin 78% Walla Walla River
Little Goose	19 (0 - 5)	179 - 580	38% Tucannon River 72% Unknown origin
Lower Granite	14 (0 - 9)	265 - 410	8% Tucannon River 92% Unknown origin

[a] This column updated from PTAGIS (accessed June 11, 2022)
Source: PTAGIS, cited in USFWS 2020 (p. 129)

Through the Project BA (p. 46), the Corps provided fish ladder counts for the four Snake River dams and McNary dam (Table 6) between 2014 through 2021. During this period, monitoring was excluded from November through March at most dams. Daytime-only winter counts are made at each dam once every 5 years on a rotating basis with the exception of Lower Granite where daytime counts are made at all times except for a one-month period when the fishway is dewatered for maintenance (Tice, B., in litt. 2022c). Despite the greater counting effort, fewer bull trout are counted at Lower Granite compared to Lower Monumental or Little Goose Dams (Table 5 and Table 6), suggesting fewer bull trout are present in the upper portion of the Action Area or perhaps bull trout that enter the lower Snake River upstream of Lower Granite Dam are more likely to remain upstream of the dam and/or outside of the reservoir.

Table 5. Fish ladder counts of bull trout at Corps dams on the lower Snake River (2006 – 2013). Fish counts exclude December through February.

Dam Facilities	Total Number of Bull Trout Recorded by Year								
	2006	2007	2008	2009	2010	2011	2012	2013	Total
Ice Harbor	0	0	0	0	0	3	0	1	4
Lower Monumental	2	4	2	5	12	47	27	26	125
Little Goose	3	6	27	37	73	161	42	64	413
Lower Granite	2	8	8	6	8	1	2	0	35
Total	**7**	**18**	**37**	**48**	**93**	**222**	**63**	**91**	**579**

Source: PSMP BO (USFWS 2014a, p. 36)

Adult and subadult bull trout use the lower (mainstem) Clearwater River, Middle Fork Clearwater River, and their tributaries primarily as foraging, migratory, subadult rearing, and overwintering habitat (USFWS 2015c), although the extent of use is unclear, confounded by the fact that there are no detection arrays in the lower mainstem Clearwater River. Detection arrays in Clearwater River tributaries have either been decommissioned or have no bull trout detections. Studies have documented bull trout originating from local populations in the upper Clearwater River watershed migrating downstream as far as Lewiston, Idaho (USFWS 2008b, p. 33), which is at the upper end of the Action Area just above the confluence of the Snake and Clearwater Rivers. Two Tucannon-origin bull trout, PIT-tagged in the lower Snake River at Lower Granite Dam, were subsequently detected in larger rivers of the Clearwater basin (PTAGIS 2022), demonstrating connectivity between the Snake and Clearwater Rivers. Bull trout abundance is believed to be very low throughout the Clearwater River shared FMO area (USFWS 2002a).

Table 6. Bull trout fish ladder counts for Corps dams in Snake and Columbia rivers in the Action Area. Fish counts exclude November through March (Tice, B., in litt. 2022c).

Dam Facilities	Total Number of Bull Trout Recorded by Year								
	2014	2015	2016	2017	2018	2019	2020	2021	Total
McNary Dam	0	0	0	0	0	1	0	0	1
Ice Harbor Dam	0	0	0	0	0	0	0	0	0
Lower Monumental Dam	24	3	5	5	0	0	6	2	45
Little Goose Dam	41	3	17	2	0	5	1	3	72
Lower Granite Dam	2	0	7	0	0	0	1	3	13
Total	**67**	**6**	**29**	**7**	**0**	**6**	**8**	**8**	**131**

Source: Excerpted from BA, p. 46

Long distance migrants, those that migrate from their natal tributaries to the lower Snake River, and likely the Clearwater River, represent a small subset of their local populations (Warnock et al., 2011 and Schaller et al. 2014, cited in Barrows et al. 2016, p. 166). Studies have shown approximately 15 to 20 percent of bull trout from the Wenatchee River Core Area make long distance migrations, including into other Core Areas. Limited evidence from radio telemetry and PIT-tagged individuals found between 6 and 29 percent of bull trout captured in the Tucannon River entered the reservoir-influenced section of the lower Tucannon or the mainstem lower Snake River between 2002 and 2009 (Barrows et al. 2016, p. 84). Other Core Areas, such as the Methow Core Area, display similar trends (*in* USFWS 2020, p. 120). Although a small representation of their local population, long distance migrants tend to be larger and more fecund, and contribute to the resiliency of bull trout through their greater potential for connectivity among subbasins and possible recolonization in areas where bull trout have become extirpated.

In general, sub-adult bull trout migrate from their respective subbasins to the Snake River during the fall/winter (from October to February), and to some extent during the spring/early summer (April to June) (Barrows et al. 2016, p. 170). Upstream movements within the mainstem river corridor were most common during the spring and summer (from March to September), and less frequent from October to November. Subadults can spend multiple years utilizing FMO habitat in the mainstem before migrating back into tributaries to spawn. Adult bull trout move into the mainstem Snake and Columbia Rivers immediately after spawning, generally between September and December (Barrows et al. 2016, p. 178). Downstream movements have been documented in the mainstem during all months (Barrows et al. 2016); however, downstream passage timing for bull trout includes the time period when the juvenile fish bypass systems at the dams are shut down, leaving the turbines and adult fish ladders as the remaining downstream passage routes (Barrows et al. 2016). Limited studies suggest pre-spawning bull trout migrate to spawning tributaries more often during the day while in the Columbia River, switching to nighttime migration only upon entering spawning tributaries (Nelson et al. 2012, p. 57). Within both tributaries and mainstem, out-migration to the mainstem tends to occur more frequently at night (Barrows et al., 2016). We expect a similar pattern throughout the Action Area and assume both adult and subadult bull trout may occur in the Action Area during project implementation.

Radio-tagged bull trout from mid-Columbia subbasins exhibit a wide range of behaviors, moving upstream, downstream, displaying high fidelity to an area, or showing no discernible pattern to their movements (Barrows et al. 2016). We expect a similar pattern in the lower Snake and Clearwater River basins, dependent on habitat conditions and local population characteristics. The proposed project will occur largely outside of peak migration, but a limited number of individuals may be migrating during project implementation, including day-time migration when project activities are most likely to occur. Given the timing of the proposed project, between December 15 and March 1, we expect most bull trout in the Action Area would display overwintering behavior. Overwintering generally occurs in FMO reaches of mainstem river systems, either in the lower reaches of natal streams or in the mainstem of the mid-Columbia, Snake, or Clearwater Rivers. Habitat use of bull trout in the lower Snake and Clearwater Rivers is poorly understood, so we are unaware of overwintering behavior in close proximity to the dredging and disposal sites, where the highest degree of disturbance is expected. However, overwintering is presumed where suitable habitat, such as cover and foraging, is available. Once established, some bull trout may display high fidelity to fixed overwinter sites, displaying limited movement during the overwintering period (i.e., “station-keeping behavior”), which is synonymous with observations in other study areas (Jakober et al. 1998; Schoby 2006).

In general, we expect bull trout to occur primarily in areas of abundant food resources and cold water refugia while in the mainstems of the Snake and Clearwater Rivers, and would likely avoid areas of slack water, limited cover, or where predation by larger fish is possible, such as near docks and riprap. Bull trout in the Columbia River have been documented using deep, slow water habitat, but use of near-shore, shallow water habitat is less known. In the absence of direct studies, we assume bull trout behavior is similar to that documented in other geographic areas. In terms of daily movement patterns, adult and subadult bull trout generally display distinct diel (i.e., 24-hour cycle) habitat use patterns (Goetz 1994, Jakober et al. 2000, Al-Chokhachy and Budy 2007, Muhlfeld et al. 2012), tending to use relatively deep pools with abundant cover (e.g., large woody debris, river bottom depressions) and higher velocity flows during the day.In contrast, nighttime habitat use by bull trout is characterized by near-shore areas with shallower depths, less cover, and slower water velocities (Gutowsky et al. 2013, p. 368; see Al-Chokhachy et al. 2010).

As described in Barrows et al. (2016, pp. 181), once in the mainstem mid-Columbia and lower Snake Rivers, bull trout dispersal is influenced by both environmental and biotic factors including water temperature and velocity, physical habitat features, predation, and competition. Spatial and temporal movement and distribution is also limited by behavioral, physiological, and energetic limitations. Arguably an outcome of the physiological or energetic limitations associated with travelling over long distances combined with traveling through degraded or adverse habitat conditions, the number of bull trout making long-distance migration appears to decrease with the number of dams and with the distance from natal tributaries (Barrows et al. 2016). Based on this information, we expect that, of the proportion of bull trout that leave their natal streams to enter the mainstem rivers, a small subset is likely to display long-distance migratory behavior and an even smaller subset is expected to migrate far enough and survive long enough to contribute to the density of bull trout in the Action Area. Habitat suitability for bull trout in the lower Snake River has not been thoroughly assessed, but some challenges to migration and survivorship have been identified.

9.2 Condition of Habitat in the Action Area

As described in the BA (pp. 6-7), the confluence of the lower Snake River and Clearwater Rivers occurs at the approximate point of the river-to-reservoir interface for the Lower Granite reservoir. The confluence is bounded by Lewiston, Idaho, and Clarkston, Washington. The Snake River’s interface with the Lower Granite reservoir begins approximately two miles upriver of the confluence. Gravels and large sands are generally deposited above the confluence. At the confluence, the river’s suspended sediment load is primarily smaller sands, silts, clays, and other fine particles. Sampling has shown that sand is the dominant material. The Clearwater River interface with the Lower Granite reservoir begins almost at the confluence. The combination of river-to-reservoir interface and the confluence of the two rivers cause both rivers to lose energy. The result is an ongoing deposition of sediment within the confluence area. The Lower Granite reservoir is estimated to trap approximately 85 percent of the sediment entering the reservoir, with approximately 50 percent of the total sediment load entering the reservoir settling out in the area of the confluence between Snake RM 120 and Lewiston, Idaho.

At the Ice Harbor Dam, materials are cobble and gravel, similar to the riverbed materials in adjacent areas outside the navigation channel and just below the dams. The cobble and gravel are too large to be readily suspended and are not likely to be bedload, as bedload is unlikely to pass through the locks or over the dam. The source of these unwanted sediment deposits are believed to be a redistribution of local riverbed material caused by flow passing through the spillways during high flows and navigation. Discharge through the spillways has been increased in the past to aid downriver juvenile salmonids passage through each dam. Spill flows at the dam have scoured rock from the base of the four rock-filled coffer cells bordering the lock approach and have pushed material from the edge of the lock approach into the channel, narrowing the room available for barges to maneuver between the coffer cells and the north shore. In addition, at least one of the coffer cells has been losing rockfill through the exposed base and this may be contributing to the material encroaching in the lock approach. Hydraulic actions of barge guidance into the locks and initiation of passage through the locks causes sloughing of steep channel slopes.

The Corps has periodically removed some of this material by dredging to provide access to ports and to maintain the navigation channel. Dredging operations impact bull trout primarily through degradation of water quality parameters that results in sublethal impacts to a few individuals. The USFWS completed formal consultation on dredging operations in the lower Snake River most recently in 2006 and 2014. In the past, the Corps has used dredge material to create shallow water benches, primarily for subyearling SRF Chinook salmon habitat. This approach was used in 1989 to construct a 0.91 acre island in Lower Granite Reservoir (Centennial Island RM 119) (Chipps et al. 1997) and in 2006 to create shallow water habitat at Knoxway Bench (RM 116.6). The shallow-water habitats surrounding Centennial Island are heavily used by subyearling Chinook salmon and Knoxway Bench is also used (Tiffan and Connor 2012). The Corps' current definition of shallow-water habitat is water less than 20 ft deep; however with recent information on the higher use of habitat less than 6 ft deep, this criterion continues to be evaluated as part of research efforts ((Tiffan and Connor 2012).

The lower Snake River is confined and controlled by four hydroelectric, concrete, run-of-the-river dams, all part of the Federal Columbia River Power System (FCRPS). The three lower dams, Ice Harbor, Lower Monumental and Little Goose each create a reservoir that extends upstream to the next dam. The fourth dam, Lower Granite creates a reservoir that extends 46 miles upstream on the Snake River to Asotin, Washington and abve the confluence with the Clearwater River near Lewiston, Idaho.

Throughout the Action Area, bull trout populations face threats from connectivity impairment and reduced access to historic FMO habitat in the mainstem Columbia and lower Snake Rivers (USFWS 2015b). The dams and reservoirs within the Action Area are part of the aforementioned Columbia River System, which is comprised of a series of multi-purpose, hydroelectric facilities constructed on the lower Snake and Columbia Rivers and operated by the Corps and U.S. Bureau of Reclamation. All of the dams on the lower Snake River are operated by the Corps as run-of-the-river facilities primarily for navigation, hydropower production, and flood control. Under current operations, the pool elevations of the reservoirs within the Action Area have a maximum potential fluctuation of about five ft. Although bull trout have been documented moving both upstream and downstream of the dams on the lower Snake River (Barrows et al. 2016), fish passage facilities are not designed for migratory bull trout, and movement may be discouraged or delayed (delays have been documented at Little Goose and Lower Granite dams), and bull trout may experience temporary fatigue that ultimately reduces fitness (USFWS 2020, p. 203). Maintenance during the winter period temporarily restricts or eliminates upstream movement, depending on the number of fishways at each dam, which may result in delayed movement, reduced access to foraging opportunities, and potentially contributes to missed spawning opportunities (USFWS 2020, pp. 212-213). Entrainment over dams may result in injury or mortality, although some structural improvements (e.g., turbine operation and juvenile bypass sytems) at Ice Harbor and Lower Granite Dams have improved conditions in recent years (USFWS 2020 pp. 216-217, 221). Entrained bull trout that are not removed prior to transportation are relocated and released below Bonneville Dam and no longer contribute to the population (USFWS 2020, p. 222-223). The extent of passage failures, entrainment, injuries, or deaths is unknown (Barrows et al. 2016; USFWS 2020, pp. 212, 223).

Altered hydraulic conditions in adjacent reservoirs create barriers to movement through sudden changes in velocities, discharge, or water surface elevations that affects fish movement through the reservoirs, disturbs shoreline or shallow water areas and possibly strands fish in shallow areas when flows recede quickly (USFWS 2020, pp. 203-204). In addition, bull trout face degraded water quality, reduced habitat complexity, altered food sources and availability, and direct handling during salvage operations, which is expected to reduce the health and fitness of affected bull trout, delay or result in missed spawning opportunities, and cause injury and mortality of affected bull trout. As previously discussed, the USFWS recently completed formal consultation on the operation and maintenance of 14 federal, multiple use dams and reservoir projects to bull trout and designated bull trout critical habitat (USFWS reference number 01EWFW00-2017-F-1650) that included those impacts stemming from operation and maintenance of the four federal dams along the lower mainstem Snake River. Impacts from the ongoing operation and maintenance activities at these federal facilities to bull trout is considered in the baseline (USFWS 2020).

In addition, bull trout originating in the Wenatchee or Entiat must pass through five non-federal, hydro-electric dams located outside of the Action Area on the Columbia River upstream from the Snake River confluence. Each non-federal hydroelectric project has undergone Federal Energy Regulatory Commission (FERC) consultation with the USFWS on operational impacts to bull trout and designated bull trout critical habitat including flow and backwater fluctuations at tributary mouths, and each coordinates their operations with other dams (USFWS 2006; 2007; 2008c; 2011; 2012). The impacts of the ongoing operation of these dams, for the length of their FERC licenses, is included in the baseline and is hereby incorporated by reference.

With the construction of the dams, formerly complex habitats in the mainstems of the lower Snake and Clearwater Rivers, as well as some of the lower reaches in the neighboring major tributaries, have been inundated and the natural sediment transport cycle has been disrupted. These impacts generally reduced rivers to single, relatively deep channels and ultimately reduced or disconnected floodplains, side channels, and off-channel habitats (Sedell and Froggatt 1984; Ward and Stanford 1995; Ward et al. 1999). Instream habitat complexity and the availability of shallow-water habitat less than six ft that provides rearing habitat for anadromous salmonids, bull trout prey items, has been reduced and riparian vegetation growth is limited. The reservoir shorelines throughout the Action Area are often steep and characterized by cliffs and talus substrate, while much of the remaining shoreline areas are lined with riprap (i.e., armoring of the banks with stone to prevent erosion) to protect adjacent structures. Relatively little riparian vegetation remains along the shorelines within the Action Area and the remaining riparian areas are highly fragmented (USFWS 2020, pp. 224, 226).

Water quality is impaired through elevated total dissolved gases, (infrequent) sedimentation and turbidity releases, and reduced nutrient availability due to the reduction in salmon and steelhead populations (USFWS 2020). Temperature, dissolved oxygen, and pH are water quality impairment pollutants identified in the Snake River where it flows into Lower Granite Reservoir (WDOE 2021) and the Action Area in Idaho and Washington. Dissolved oxygen levels in the Snake River at the head of the Lower Granite Reservoir may be quite low from early summer to fall, because dissolved oxygen is primarily reduced by high water temperatures (NMFS 2004a; USEPA 2020). Increased water temperatures reduce the availability of cold water refugia and introduce thermal migratory barriers. Altered stream temperatures are especially prohibitive of bull trout in the warmest months, particularly downstream from Dworshak Reservoir in the lower Clearwater River. During late spring and summer, water is released from lower levels of the Dworshak reservoir to help cool water temperatures in the lower Snake River downstream of the Clearwater and Snake River confluence. The volume of water released is enough to double the natural flows in the lower Clearwater River in the Action Area. These cooler waters improve thermal conditions for bull trout, salmon, and steelhead below Lower Granite Dam and into the Little Goose Reservoir (Cook and Richmond 2004, p. 1; USFWS 2020, p. 328).

Increased water temperatures create environments favorable to non-native fish predators (ISG 1998; NRC 1996) that exposes migratory bull trout and their native prey base to potential predation by larger non-native piscivores. Through sampling of all four reservoirs in the lower Snake River, studies found that smallmouth bass were the most common predator of all of the eight predatory species (northern pikeminnow, smallmouth and largemouth bass, walleye, yellow perch, white and black crappies, and channel catfish) (Seybold and Bennett 2010). Smallmouth bass were most abundant in Lower Granite reservoir, while northern pikeminnow were more abundant at sampling stations downstream of Lower Granite Dam. Delayed downstream migration caused by dam impoundments also contributes to increased predation of anadromous salmon and steelhead that reduced forage base for bull trout; however, bull trout may also prey on non-native fishes. Only the largest predatory fish would prey on bull trout in the Action Area.

In addition to dams, numerous other anthropogenic features or activities in the Action Area (e.g., ports, docks, roads, railroads, bank stabilization, irrigation withdrawals, and landscaping) have become permanent fixtures on the landscape, and have further displaced and altered native riparian habitat. Consequently, the potential for normal riparian processes (e.g., litter fall, channel complexity, and large wood recruitment) is diminished and aquatic habitat has become simplified. Shoreline development has eliminated or interrupted normal riparian processes, facilitated replacement of native vegetation with invasive non-native species, and reduced the quantity and quality of nearshore salmon and steelhead habitat. The riparian system is fragmented, poorly connected, and provides inadequate protection of habitats and refugia for sensitive aquatic species. Snake River Plateau soils are highly erodible and wind erosion is exacerbated by agricultural practices (BA, p. 56), which contributes additional sediment to the system.

Contaminants associated with urban development, roads and vehicles, stormwater discharge, and dam and levee operations (in additional to collective effects from upstream agriculture and irrigation, mining, foresty, and grazing) that are in solution or suspended in the water column are transported on water currents or settle onto substrates, contributing to degraded water quality conditions. Contaminants that have been identified in the Action Area include mercury, copper, and other metals; chlorinated pesticides and their degradates (DDT, DDD, DDE), polychlorinated dibenzo-p-dioxins and furans, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), PAHs, and many others (see NMFS 2021). Sampling at multiple sites in the lower Snake River, from Ice Harbor dam to Clarkston, Washington found no site met the State of Washington's water quality standards fish tissue/human health criteria for fish consumption because of elevated levels of contaminants in one or more species of fish (Seiders et al. 2011). At toxic levels, contmainants can cause a range of behavioral, sublethal and lethal effects to aquatic orgamisms, can alter benthic invertebrate communities and foraging habits, bioaccumulate in benthic and fish tissue, and can biomagnify across the food web (see NMFS 2021). Typically, long-lived, larger-bodied, higher trophic-level piscivores, and strongly benthic fishes have highest concentrations of bioaccumulate and biomagnified contaminants in tissues.

Persistent Bioaccumulative Toxicants (PBTs), a group of contaminants with similar modes of action, persist for several years while maintaining high toxicity (see NMFS 2021). PBTs are often found in mixtures together with a broad range of PAHs and metals, to which PBTs readily bind and interact; often-increasing toxicity and mobility. Microplastics, found in considerably higher concentrations in stormwater runoff in western states (Brahney et al., 2021) are infused with PBTs. One of most common microplastics entering aquatic habitats from proximate roadways and stormwater discharges are tire tread wear particles (Tian et al. 2020; Brahney et al. 2021). The 6PPD-quinone, a transformative of the preservative in tires exposed to ozone, is acutely toxic to juvenile and adult salmonids and is identified by Tian et al. (2020) as the primary cause of urban runoff mortality syndrome described by Scholz et al. (2011). Persistent organochlorine pollutants (POPs), some of which were discontinued 15 to 30 years ago, are another form of PBTs that still exceed benchmarks for human health, aquatic life, and fish-eating wildlife in water, bed-sediment, and fish tissue samples in the Snake and Columbia Rivers (see NMFS 2021; WDOE 2021).

Sediment core samples from Lower Granite Reservoir were found to contain high concentrations of metals in fine grained sediments. Higher velocity currents and turbulence at the confluence typically carry contaminated suspended solids and sediments farther downstream where particles settle in substrate depressions and other areas of slower current (Braun et al. 2012), including those along shallow water and nearshore habitats where juvenile salmonids rear and feed. Consistent concentrations in cores extending from substrate surfaces to five feet in depth indicate contaminant loads are continually delivered, and metals are often found at the highest concentrations at or near the substrate surface. Sediment concentrations of several metals, including copper, chromium, and mercury (MacDonald et al. 2000; Braun et al. 2012), exceeded harmful effects thresholds and reduce or alter benthic invertebrate communities, a primary food source for juvenile salmonids. A reduction in the availability of energy rich benthic species leads to foraging patterns that increase bioaccumulation rates in rearing salmonids (Farag et al. 1998; Bettaso and Goodman 2010) that can be passed to higher trophic levels.

The Corps has identified a range of potential chemical contaminants that could be present in the river sediments near the confluence of the Snake and Clearwater Rivers, including total organic carbon, semi-volatile organic compounds, heavy metals, polychlorinated biphenols (PCBs/Arochlors), petroleum hydrocarbons, pesticides, and other potential contaminants. Under the PSMP, the Corps performs site-specific sediment sampling to identify potential contamination at dredging locations. The most recent sediment samples collected in 2019 were tested for these constituents of concern, as well as testing for dioxans/furans due to the presence of a paper company outfall just upstream of the Snake/Clearwater confluence. Water quality monitoring, required under the National Pollutant Discharge Elimination System permitting, does not require testing for dioxins and furans. Results confirmed that dioxins/furans are not currently a chemical of concern (Corps 2020, p. 5). Bioassay analysis, to determine the potential toxicity of dredge sediments to benthic/ epibenthic organisms, relative to an upstream reference site, was conducted at two Port of Clarkston locations following screening level exceedances for 4-methylphenol (2014 sampling documented exceedances, as well). All test sediments passed, and are considered suitable for open-water disposal (Corps 2020, p. 6).

With the creation of the Lower Granite Reservoir in 1975, approximately 40 to 60 percent of shallow water sand bar habitat was converted to either mid-depth bench or deep water habitat (BA, p. 59), reducing spawning and foraging habitat for some native salmonid species, except for a few accumulations of suitable spawning gravels for SRF Chinook salmon in the tailraces of the dams. Recent modeling (Tiffan and Hatten 2012) suggests that shallow water rearing habitat is available in approximately seven percent of the Lower Granite Reservoir. Some of the shallow water areas occur at the margins of in-channel islands and mid-channel shelves, and are maintained due to the relatively small fluctuations in water level (i.e., typically less than 5 ft) from operations at Lower Granite Dam. The Corps has used dredge material to create shallow water benches following previous dredging operations, in 2006 and 2014, as previously described. The consistent water levels of the reservoir also help to maintain benthic habitat and production of benthic invertebrates, which comprise an important food source for many potential prey species (e.g., anadromous salmonids) of adult bull trout. Shallow, backwater areas with low water velocities, relatively warm water temperatures, and accumulations of fine-grained sediments are very limited in the reservoir, and are favored by resident centrarchids (e.g., rayfinned fish such as bass and bluegill) for spawning and rearing. Aquatic macrophyte production in the reservoir is also very limited due to a lack of shallow, backwater areas.

The Corps maintains a navigation system through the lower mainstem Snake River and upstream on the Clearwater River above Lewiston, Idaho, to facilitate river transportation by vessels (barges and other large vessels). Commercial barge traffic on the lower Snake River fluctuates from year to year, depending on crop production, the state of the U.S. economy, and trends in world trade. As described in our 2014 PSMP BO, the tonnage moved has ranged from a high of 8,670 million tons in 1995 to a low of 5,301 million tons in 2008 (includes the Columbia River portion of McNary Reservoir: USFWS 2014a, p. 34). The effects of barge operations on salmonids include spillage or leakage of contaminants (such as fuels, oils, or grease), generation of wakes and turbidity by moving vessels, and through creation of overhead shade when shipping vessels are moored. Barge traffic has likely caused minor effects to fish through direct impacts of moving vessels. Effects of shipping vessels are limited in severity due to physical characteristics of the Snake River and the size of the vessels that can navigate the river. While the river is relatively wide, the 14-foot depth of the navigation channel limits commercial traffic to barges which have a shallow draft that is not capable of producing high-amplitude wakes that might strand fish or cause trauma from the wave energy. Moored barges may provide cover for predatory fish.

9.2.1 Summary

Connectivity is important between bull trout local populations, Core Areas, and forage, migration, and overwintering (FMO) habitats. The lower Snake and Clearwater Rivers provide FMO habitat for bull trout from Core Areas in the Walla Walla River, Wenatchee River, Entiat River, Tucannon River, Asotin Creek, Imnaha River, Grande Ronde River, and upper Clearwater River. The origin of some bull trout in the lower Snake or Clearwater Rivers is known, originating in the Walla Walla River, Tucannon River, Asotin Creek, and Imnaha River, but a large percentage of bull trout are of unknown origin. Bull trout presence from other Core Areas is assumed based on use of mainstem river system, migratory patterns, and demonstrated connectivity (i.e,. Entiat River, Wenatchee River, Grande Ronde River, and Core Areas of the Clearwater River). FMO habitats are important to migratory bull trout, since they grow larger and are more fecund than residents, therefore contributing to population stability in Core Areas. Bull trout use of the lower Snake River has been documented from observations in the fish ladders, PIT tag arrays at fish ladders and juvenile bypass systems at dams and various arrays in tributaries, through various research projects, and through anecdotal accounts. Data obtained at dams does not provide adequate information to describe bull trout density in the Actin Area, but the available information indicates that a relatively small number of bull trout may occur in the Action Area during the proposed activities and that these fish would represent migrants traveling among the major tributaries within the broader Snake, Clearwater, and Columbia River systems. We expect bull trout in the Action Area during project implementation would consist largely of overwintering individuals, but some limited migration may occur.

The status of bull trout in the Action Area is influenced by the highly degraded habitat throughout the Action Area that limits connectivity and reduces access to historic habitats. Dams have altered hydrology and introduced movement barriers, simplified in-channel habitat, reduced riparian function, degraded water quality, and created habitat favorable to non-native predators. Other human activities (e.g., construction of ports, docks, roads, railways, landscaping, agriculture) have contributed to altering or displacing shoreline riparian and in-stream habitats in the Action Area and contribute to water quality degradation. Contaminants associated with urban development, roads and vehicles, stormwater discharge, and dam and levee operations (in additional to collective effects from upstream agriculture and irrigation, mining, foresty, and grazing) that are in solution or suspended in the water column are transported on water currents or settle onto substrates, contributing to degraded water quality conditions. Some contaminants are persistent, bioaccumulate in benthic and fish tissue, and biomagnify across the food web. Bull trout originate and experience threats and stressors occurring within their natal tributaries. Within some Core Areas, such as the Walla Walla, Entiat, Tucannon, and Asotin, bull trout populations are considered depressed; that is having a small population size, experiencing substantial threats, and/or has a long-term declining trend in population or redd counts. The remaining Core Areas contributing to the Action Area are considered stable; that is, no indication of population change in the last 7 to 10 years.

9.3 Status of Bull Trout Designated Critical Habitat in the Action Area

Within the MCRU, two CHUs fall within the boundaries of the Action Area. The mainstem lower Snake River CHU (CHU 23) includes the Snake River from Hells Canyon Dam downstream to the confluence with the Columbia River. The Clearwater River CHU (CHU 21) includes all portions of the Clearwater River basin to its confluence with the Snake River. The Action Area encompasses the lower half of the mainstem Snake River CHU and a small portion (1.9 RKM or 1.2 RM, or 0.07 percent) of the most downstream extent of the Clearwater River CHU. These CHUs are essential to the recovery of bull trout because they contain PCEs that comprise suitable foraging, migration, and over-wintering habitats within the Action Area and they provide potential connectivity between multiple Core Areas in neighboring major tributaries throughout the broader region (USFWS 2010a, pp. 527 and 583). Following brief descriptions of each CHU that comprises the Action Area, we present the status of the PCE's that comprise bull trout critical habitat within the Action Area are described.

Mainstem Lower Snake River CHU 23 - The Mainstem Lower Snake River CHU consists of 451.7 km (280.6 mi) of mainstem habitat. The Action Area overlaps the lower half of the mainstem Lower Snake River CHU 23. This CHU is essential to the long-term conservation of migratory life history expression, facilitates genetic exchange, and ensures connectivity between Core Areas along the Snake River. Connectivity between populations in the Tucannon, Asotin, Walla Walla, Clearwater, Grande Ronde and Imnaha Core Areas has likely been limited by operation of Lower Granite and Little Goose dams (USFWS 2010a, 2010b). In addition to dam construction and operation, the Mainstem Lower Snake River has been altered by reduced habitat complexity, little to no natural floodplain connectivity due to levees and bank armoring, and from agricultural practices alongside the river. Bull trout are known to occupy and use the mainstem Snake River throughout the year for foraging and overwintering.

Clearwater River CHU 21 - The Clearwater River CHU consists of 2,702.1 km (1,679.0 miles) of streams, as well as portions of some lakes and reservoirs. The CHU is located in north-central Idaho and extends from the Snake River confluence at Lewiston, Idaho to the Montana border. It represents the easternmost extent of the MCRU and includes the Clearwater River and numerous tributaries, including the South Fork, Middle Fork, and North Fork Clearwater Rivers. The Action Area overlaps a very small portion of the Clearwater River CHU, specifically the Middle-Lower Fork Clearwater Critical Habitat Subunit (CHSU). In 2010, the Clearwater River CHU was determined essential for bull trout to maintain distribution in a unique area of the MCRU (USFWS 2010b). The Middle-Lower Clearwater CHSU is essential to bull trout conservation because the Clearwater River and Middle Fork Clearwater River primarily serve as migratory corridors, connecting bull trout local populations within the Clearwater River CHU as well as maintaining connectivity to other Mid-Columbia River bull trout populations. These mainstem river reaches also provide important foraging and overwintering areas for subadult and adult bull trout that originate in upstream CHSUs (USFWS 2010b).

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

PCE 1 in the Mainstem Lower Snake River CHU has limited interaction with its historic floodplain. The riparian corridor and shoreline are heavily impacted by railroad and highway levees, bank armoring, and dam operations. Approximately 44 percent of the Lower Granite Reservoir is lined with riprap (Tiffan and Hatten 2012, cited in USFWS 2014a, p. 31). Tributary inflow may also play a role in providing subsurface connectivity between cold-water refugia in the reservoir and tributary habitat. Some groundwater influence may occur in riverine areas of the mainstem not dominated by bedrock or immediately below dams, although little is known regarding the ecological significance of this exchange (Corps 2013). Areas throughout the mainstem that provide some cold water or natural hyporheic connectivity likely provide bull trout in the mainstem with summer refugia, particularly for sub-adults.

Within the Clearwater River CHU portion of the Action Area, U.S. Highway 12 and the Camas Prairie railroad parallel the river. This encroachment reduces the connectivity of the mainstem to off-channel habitat that may support wetlands and other sources of cooling groundwater (USFWS 2002a). The porion of the Action Area that overlaps the Clearwater River CHU is heavily developed and the entire mainstem area is lined with riprap (USFWS 2014a).

This PCE is considered **Not Properly Functioning** within the Action Area due to lost wetlands and reduced or lost floodplain and off channel connectivity from dam operations and shoreline development.

PCE 2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, over-wintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

Within the Clearwater River CHU portion of the Action Area, there are no known migration barriers and, while migration corridors are present in the Mainstem Lower Snake River CHU, they are limited. Fish passage facilities are present at the four Lower Snake River dams, but still pose difficulties, likely passage delays, and mortality risks for passage. The incidental collection of bull trout at juvenile bypass facilities, the observation of bull trout within adult fish ladders, and radio telemetry and PIT tag research have shown that bull trout utilize the mainstem Snake River as a migratory corridor as well as deep-water habitat for overwintering and feeding (USFWS 2015b); however, the extent of bull trout use and efficacy of passage is not fully understood because monitoring at dams is limited when bull trout are most likely to be present. The loss of migratory corridors through habitat fragmentation associated with dams has been identified as a threat to the diversity, stability, and persistence of bull trout populations (Kuttel 2002; USFWS 2015b). Thermal barriers between tributary habitat and the mainstem Snake River exist seasonally and further impact the function of this PCE in the Action Area. Seasonally high river temperatures may delay or impede migration to and from spawning areas and FMO habitat, potentially exacerbated by migration delays at dams.

Based on the above information, and the fact that the Mainstem Lower Snake River CHU influences the condition of the Action Area more substantially than the Clearwater River CHU, the USFWS considers PCE 2 **Functioning at Risk** in the Action Area.

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

PCE 3 is present and contributes to FMO habitat in this reach of the Mainstem Lower Snake River CHU. The conversion of mainstem habitat from riverine flow to a lacustrine-like condition has altered the prey composition in the mainstem Snake River. Conversion of aquatic habitats due to backwatering effects of dams and degradation of the riparian corridor have negatively affected the productivity of native species; however, these habitat changes have increased non-native fish production to provide a prey base for bull trout (USFWS 2010a, b). Native species of fish, including salmonids and steelhead, still occupy the reservoirs and also provide a food source for bull trout. The number of non-salmonid fish predators has increased since the Lower Snake River reservoirs were created (USFWS 2002b). Armoring along the mainstem Clearwater River CHU has reduced the presence of riparian vegetation and the associated input of allochthonous (i.e., not indigenous) prey items that contribute to productivity of bull trout prey base.

Contaminants in water and sediment are associated with adverse effects in native salmonids, contributing to harmful body burdens and lipid concentrations that reduce survival and are passed along to eggs and larvae that are more sensitive to mortality. Metals are often found at the highest concentrations at or near the substrate surface and are readily available to benthic invertebrates, a primary food source for juvenile salmonids, which reduces the availability of energy rich benthic species and leads to foraging patterns that increase bioaccumulation rates in rearing salmonids (Farag et al. 1998; Bettaso and Goodman 2010). Many contaminants become bound to biofilms and detritus that are consumed by benthic species, bioaccumulating and subsequently loading to fish tissue to biomagnify through throphic levels. Concentrations of one or more contaminants in the fish tissue of multiple species in the lower Snake River were found to exceed the State of Washington’s water quality fish tissue/human health criteria for fish consumption (see NMFS 2021). Contaminants negatively affect the productivity of bull trout prey base and, thus, the function of PCE 3 by reducing growth, reproduction, and survivorship across trophic levels of the food web.

Based on reduced native salmon forage, negative impacts of contaminants to the food web, and degraded riparian function throughout the Action Area, the USFWS considers this PCE **Functioning at Risk**.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as Large Woody Debris (LWD), side channels, pools, undercut banks, and unembedded substrates to provide a variety of depths, gradients, velocities, and structure.

PCE 4 is impaired in the Mainstem Lower Snake River CHU. The mainstem habitat is composed of deep reservoirs with little to no habitat complexity, and only a few tributaries enter the reservoirs. A few backwater areas have been inundated by the impoundment. Recruitable large wood is limited in the Lower Snake River reservoirs, and off-channel habitats are scarce. Most of the existing woody debris is high up on the shorelines or floats down the river and is trapped behind the dams (BA, p. 61). Where available, riparian vegetation along the Lower Snake River is dominated by Russian olive (*Elaeagnus angustifolia*), with some black cottonwood (*Populus trichocarpa*), black locust (*Robinia pseudo-acacia*), and various alder and willow shrubs. The steep shorelines and arid landscape associated with project reservoirs limit development of riparian communities (Corps 2002). Streambanks along the Snake River are sparsely vegetated and often armored with riprap, especially along the banks immediately downstream of dams, to prevent erosion during larger spill events. Reservoir habitat is generally uniform and does not form complex pool habitat common in smaller streams. Little Goose and Lower Monumental Reservoirs have a greater number of backwater areas than Ice Harbor. The confluences of two major tributaries (the Palouse and Tucannon Rivers) with the Snake River provide additional backwater habitat in Lower Monumental Reservoir. These reservoirs tend to support species that depend on shallow-water habitats during some part of their life histories (Corps 2002). Emergent wetland habitat increased significantly after construction of the dams and impoundments due to sedimentation and flooding of backwater areas (Corps 2002).

The presence of Federal, state, and county roads in the lower reaches of the Clearwater River CHU, including U.S. Highway 12, have reduced shoreline and in-stream habitat complexity through a reduction of recruitable LWD and an associated reduction in pools and habitat complexity. High levels of sediment in the mainstem result in substrate embeddedness in lower velocity areas, which may reduce substrate complexity and the depth of holding pools.

Habitat complexity in the Action Area is **Not Properly Functioning** based on the information above.

PCE 5: Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range.

In the designation of critical habitat, PCE 5 was identified as not present year-round in the Mainstem Lower Snake River CHU due to construction of the dams and elevated temperatures. While not identified as a PCE in the CHU, temperatures in the Snake River influence distribution, migration, and foraging opportunities for bull trout throughout the Action Area and between Core Areas. Seasonally, elevated temperatures in passage facilities and in the river impede movement of bull trout, specifically non-spawning adults and sub-adults. Summer water temperatures in major tributaries neighboring the Action Area (e.g., Tucannon River, Asotin Creek) are also significantly elevated, primarily as a result of warm return flows from adjacent farmland and developed areas, and contribute to the degraded water temperature conditions within the Action Area. Although cold water releases from Dworshak Dam occur from about early July through mid-September and can help to increase flow and reduce high temperatures of water entering the Snake River above Lower Granite Dam, no measureable difference in water temperature is expected below Little Goose Dam (USFWS 2020, p. 238). In the winter time, during Project implementation, we expect much colder waters, and water temperatures within the identified range appear to be available (BA, p. 60; USGS 2022). Water temperature in the Clearwater River is expected to be somewhat cooler.

While PCE 5 is generally present in the mainstem of the Clearwater River CHU downstream of Dworshak Dam, summer impairments are common. Coldwater releases from Dworshak Dam reduce summertime water temperature in an attempt to create more favorable conditions for migrating juvenile salmonids. Streambank armoring associated with numerous roads, including U.S. Highway 12 along the Clearwater River, has resulted in a loss of shade-producing vegetation from the mainstem riparian corridor. The presence of major roads immediately adjacent to the mainstem has reduced the connectivity to floodplain habitats, resulting in the interception of groundwater that could contribute to in-stream cooling. The presence of numerous stormwater outfalls along U.S. Highway 12 likely contributes to elevated in-stream temperatures in localized shoreline habitats.

Based on this information, and the minor contribution of the Clearwater River to the Action Area, we assume PCE 5 is **Not Present** in the Action Area.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Spawning and rearing does not occur within the Mainstem Lower Snake River CHU. Spawning and rearing habitat occurs within the Clearwater River CHU but not within the Action Area. Therefore, this PCE is **Not Present**.

PCE 7: A natural hydrograph, including peak, high, low and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

The natural hydrograph is significantly impaired by the presence and operation of dams throughout the Mainstem Lower Snake River CHU. The mainstem Snake River upstream of Lower Granite Dam is influenced by operations at the Hells Canyon Complex and Dworshak Dam on the Clearwater River. While the four dams on the Lower Snake River are run-of-river facilities, their presence and operations maintain and enhance reservoir habitat resulting in changes to flow regimes, backwatering in tributaries, and changes to sediment and substrate composition. Overall, storage dams throughout the Columbia River Basin have dampened the pre-dam hydrograph, with decreased high flows during the summer and increased low flows during the winter (National Research Council 2004). Flows can also vary on shorter timescales (i.e., daily) to optimize power generation during peak energy demands.

The mainstem Clearwater River CHU below the confluence with the North Fork and throughout the Action Area portion of the CHU is influenced by Dworshak Dam operations (Ecovista et al. 2003, p. 10). Before the construction and operation of Dworshak Dam in late 1971, the natural hydrograph of the lower Clearwater River downstream of the dam consisted of a spring freshet with high peak flows, followed by a rapid drop in flows into August. Since the construction and operation of the dam, the hydrograph is similar, though peak flows, on average, have decreased during the spring freshet.

Operations of four dams on the Lower Snake River as well as upstream dams in the Snake and Clearwater Basins alter the flow regime and hydrograph throughout the Action Area. Therefore, this PCE is **Not Properly Functioning** within the Action Area.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

PCE 8 is impaired in the Mainstem Lower Snake River CHU and provides a limited contribution to FMO habitat in the lower mainstem Snake River. Impoundment of the river has altered flow characteristics and temperature regimes, and one of the primary water quality constituents affecting bull trout use of the mainstem Snake River is temperature (see PCE 5). Water quality in the mainstem Snake River is also limited by several pollutants, including sediment, bacteria, DO, nutrients, pH, mercury, pesticides, and TDG. Dissolved gas supersaturation (in excess of state standards of 110 percent) can harm fish, and spill from the Lower Snake River dams can cause gas supersaturation conditions. Sampling for DO levels in 2010 identified levels above 100 percent throughout the three reservoirs, and the highest values were recorded at stations in Ice Harbor Reservoir (Seybold and Bennett 2010). High flows and water turbulence from Lower Monumental Dam, combined with the respiration of abundant submerged macrophytes, could have contributed to high dissolved gas concentrations at the stations in Ice Harbor Reservoir. The Corps has installed spillway deflectors at all Snake River dams in the Action Area. The spillway deflectors are designed to reduce TDG saturation during spill. The Corps has continuously measured TDG saturation below Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams since 1990. Spill is managed to keep TDG concentrations below prescribed limits in the tailrace of lower Snake River dams during the juvenile salmon passage seasons, which is generally from April through August. Any spill occurring outside the juvenile salmon passage season is unavoidable.

Contaminants associated with urban development, roads and vehicles, stormwater discharge, and dam and levee operations (in additional to collective effects from upstream agriculture and irrigation, mining, foresty, and grazing) that are in solution or suspended in the water column are transported on water currents or settle onto substrates, contributing to degraded water quality conditions. Contaminants in the Action Area and include mercury, copper, and other metals; chlorinated pesticides and their degradates (DDT, DDD, DDE), polychlorinated dibenzo-p-dioxins and furans, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), PAHs, and many others (see NMFS 2021). Sampling at multiple sites in the lower Snake River, from Ice Harbor dam to Clarkston, Washington found no site met the State of Washington's water quality standards fish tissue/human health criteria for fish consumption because of elevated levels of contaminants in one or more species of fish (Seiders et al. 2011). Under the PSMP, the Corps performs site-specific sediment sampling to identify potential contamination at dredging locations. The Corps tested sediment samples, collected in 2019, for a number of contaminants to determine the chemical content of sediments at dredge sites in the lower Snake River and at the confluence of the Snake and Clearwater Rivers. Due to the size of material to be dredged from the Ice Harbor downstream navigation lock, no sampling was required there. Some sample sites near the confluence required additional testing due to screening level exceedances, but all test sediments passed the Corps' criteria, and were found suitable for open-water disposal (Corps 2020).

The Clearwater CHU portion of the Action Area at Lewiston, Idaho is significantly developed. U.S. Highway 12 and the Camas Prairie railroad are located within the riparian corridor and floodplain of the mainstem Clearwater River CHU. The presence of this infrastructure has contributed to decreased water quality in the form of increased suspended sediment levels and contaminants from several stormwater outfalls and other sources associated with urban development. Relatively high surface erosion potential and landslide hazards outside of the Action Area likely combine to create substantial sediment production concerns that influence PCE 8 in this portion of the Action Area. Contaminants in solution or suspended in the water column are transported downstream. As previously described, most sediments that enter the Lower Granite Reservoir settle out, which would include sediments with bound contaminants that may later be resuspended.

Based on the above information on temperatures, TDG, sediment and contaminants, PCE 8 in the Action Area is **Not Properly Functioning**.

PCE 9: Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

PCE 9 is impaired in the Mainstem Lower Snake River CHU. Conversion to a more lacustrine habitat has increased predator abundance and productivity of non-native predatory and competing fish species. Conditions in reservoir reaches, such as increased water temperatures, typically favor non-native species and these are prevalent in the mainstem Snake River. Seventeen non-native fish species currently share resources with 18 native species in the Lower Snake River reservoirs (USFWS 2002b). Although numbers differ, species composition of resident fish differs little among the reservoirs. Species found in high abundance in all reservoirs include suckers, northern pikeminnow, bass, chiselmouth, and redside shiners (Bennett et al. 1983; Bennett and Shrier 1986; Bennett et al. 1988). Crappie, sunfish, and largemouth bass are highly abundant in backwaters of all reservoirs. Most recently, walleye numbers have increased in the region. The highest densities of smallmouth bass in the Snake (and Columbia) River occurs in the Lower Granite forebay, tailrace, and reservoir (NMFS 2000a, b).

Within the larger Clearwater River CHU, this PCE is impaired due to the presence of non-native brook trout, which is identified as a threat to bull trout habitat and population sustainability in the North Fork Clearwater River (*in* USFWS 2020, p. 155). Brook trout in some spawning and rearing tributaries and mainstem FMO habitats contribute to competition, predation, range reduction, and possible hybridization with bull trout (USFWS 2015b p. C-324). There are currently several brook trout populations in the lower Clearwater Basin, including the Potlatch River system (CBBTTAT 1998b as cited in USFWS 2002a). We assume their distribution extends into the Clearwater River portion of the Action Area.

Based on the numerous species of non-native species found in the Snake and Clearwater Rivers, the USFWS considers this PCE as **Not Properly Functioning** in the Action Area.

9.4 Previously Consulted on Effects for Bull Trout and Designated Critical Habitat

The USFWS queried their on-line database of consultations as of June 19, 2018. There were 928 formal consultations that were concluded, or are ongoing, addressing federal actions that may affect bull trout. Forty of those were batched consultations covering multiple projects, and 127 were programmatic consultations. Seventy-four of the total number of formal consultations were active on that date, and the rest had been concluded. The consulted-on effects ranged from beneficial or improved conditions, to insignificant or discountable effects, and to adverse effects resulting in injury, mortality or loss of habitat function at the individual, population, and Core Area scales. Only one of the consultations was a jeopardy determination for bull trout: the consultation on Idaho Water Quality Standards for Toxic Pollutants (Reference number: 01EIFW00-2014-F-0233); this was also an adverse modification determination for bull trout critical habitat (USFWS 2015c). Numerous consultations completed across the region included bank stabilizing that in many cases resulted in loss or degraded riparian conditions.

Previously consulted on federal actions have or are anticipated to result in adverse effects to bull trout that interact with the Action Area and/or its designated critical habitat. These projects include: irrigation diversions that affect water resources in the Columbia and Snake River mainstem and tributary systems (annual water depletion varies); hatchery programs occurring on the Snake and Clearwater Rivers and within a number of tributary streams that benefit bull trout through the release of additional food sources; aquatic invasive species management (plants) that introduces chemical contaminants to occupied waterways; tributary habitat and restoration improvement programs; and sediment dredging operations within the lower Snake River that may result in adverse effects to bull trout during habitat improvement activities, but may also provide benefits through monitoring and adaptive management programs that identify and minimize the impacts to migratory bull trout, salmon and steelhead.

As previously described, the USFWS completed formal consultation with the Corps on their operations and maintenance of 14 multiple use dam and reservoir projects within the Columbia River System. Most bull trout that interact within the Action Area are affected by federal and/or non-federal dam operations. These bull trout experience passage delays, entrainment, degraded water quality, reduced habitat complexity, altered food sources and availability, and direct handling, which is expected to reduce the health and fitness of affected bull trout, delay or result in missed spawning opportunities, and cause injury and mortality of affected bull trout. In addition, altered hydrology, which reduces habitat complexity, limits riparian vegetation growth, and increases water temperatures, further exposes migratory bull trout to potential predation, reduced native food sources (e.g., salmon and steelhead), and to sublethal or lethal impacts from these stressors.

Most formal consultations for bull trout included an analysis of critical habitat, and types of activities considered would be similar. Critical habitat was designated on the mainstem lower Snake and Clearwater Rivers in 2010, and critical habitat would have been considered for federal actions on these mainstems after that date. The duration of effects can be a single event (one day or week), a year or multiple years, and in perpetuity. Life histories affected include adult holding pre-spawning, juvenile out migration, adult migration to spawning areas, subadult FMO, and adult FMO. The effects associated with all but a few of these projects sampled are now fully part of the baseline.

9.5 Summary of the Status of Bull Trout and Bull Trout Critical Habitat in the Action Area

Connectivity is important between bull trout local populations, Core Areas, and forage, migration, and overwintering (FMO) habitats. The lower Snake and Clearwater Rivers provide FMO habitat that is utilized by bull trout from several Core Areas, including the Walla Walla River, Wenatchee River, Entiat River, Tucannon River, Asotin Creek, Imnaha River, Grande Ronde River, and Clearwater River. FMO habitats are important to migratory bull trout, since migratory forms grow larger and are more fecund than residents, therefore contributing to population stability in Core Areas. Relative to other salmonids, such as steelhead or Chinook salmon, few bull trout occur within the lower Snake and Clearwater Rivers, and little is known about their specific movements and habitat use patterns, especially during the winter. Most of the available distribution data in the mainstem Snake and Clearwater Rivers was obtained during salmon monitoring or capture efforts and does not provide information from December to February, when bull trout are expected to use the mainstems for foraging and overwintering. However, we expect the proportion of bull trout in the Action Area decreases with distance from its Core Area.

Adult and sub-adult bull trout display distinct diel (i.e., 24-hour cycle) habitat use behavioral patterns (Federick 1994, Jakober et al. 2000, Al-Chakhachy and Budy 2007, Muhlfeld et al. 2012). Bull trout tend to use relatively deep pools with abundant cover (e.g., large woody debris, river bottom depressions) and higher velocity flows during the day. In contrast, night time habitat use by bull trout is characterized by near-shore areas with shallower depths, less cover, and slower water velocities. In general, bull trout would be expected to occur primarily in areas of abundant food resources and cold water refugia while in the mainstems of the rivers, and would likely avoid areas of slack water, limited cover, or where predation by larger fish is possible, such as near docks and riprap. The available information indicates that a relatively small number of adult or subadult bull trout may occur in the Action Area during the proposed activities and that these fish would represent migrants traveling among the major tributaries within the broader Snake, Clearwater, and Columbia River systems. Bull trout may occur in the Action Area year round, but are more likely to be present in the winter.

The Action Area overlaps portions of the lower Snake and Lower Clearwater River shared FMO habitats, but the lower Snake River conditions exert the greatest influence on the Action Area as a whole. Of the 8 PCEs supporting designated bull trout critical habitat in the Action Area (PCE 6 is not present, as it pertains to spawning and rearing habitat), most are either Not Functioning Properly or Functioning at Risk. PCEs 1 (Seeps and Springs), 4 (Complex Habitat), 7 (Natural Hydrograph), 8 (Water Quality and Quantity), and 9 (Non-Native Predators) are not functioning properly as a result of dam influences that include altered hydraulics and flow characteristics, along with shoreline development and other anthropogenic influences. PCE 2 (Migration Habitat) is Functioning At Risk as a result of dam impediments, and PCE 3 (Abundant Food

Base) is Functioning at Risk due to declining native salmonid foragebase and riparian function. PCE 5 is not present in the Action Area due to the influence of dams.

9.6 Conservation Role of the Action Area to the Recovery of the Species

The conservation of the coterminous U.S. population of the bull trout is dependent upon the persistence of bull trout within each of the six recovery units. Persistence of bull trout within each recovery unit is dependent upon maintaining viable Core Areas. Viable Core Areas are dependent on the persistence of local bull trout populations, which are in turn dependent upon reliable habitat connectivity for migratory bull trout that provides for genetic and demographic resiliency, especially in response to stochastic events. Therefore, recovery units should provide for the long-term persistence of self-sustaining, complex, interacting local populations of bull trout in Core Areas distributed throughout the species range.

The mainstem lower Snake and Clearwater Rivers provide essential rearing and FMO habitat for sub-adult and adult bull trout originating from tributaries connected to these waters. Bull trout from several Core Areas that contribute to the MCRU use the lower Snake and Clearwater Rivers during the year for foraging, migration, and overwintering purposes. Bull trout occupy these large rivers and associated tributary systems on a seasonal basis throughout most of the year, although warm water temperatures during summer months limits occurrence in many areas. Bull trout populations that utilize these areas vary in number, size, and stability, ranging from a few, depressed (i.e., having small population size, experiencing substantial threats, and/or has a long-term declining trend in population/redd counts) populations in the Walla Walla River, Entiat River, Tucannon River, and Asotin Creek to multiple strong populations in the Imnaha, Clearwater River, Grande Ronde River, and Wenatchee River Basins (Appendix C). The relatively small number and potential isolation of local bull trout populations in the Walla Walla River, Tucannon River, and Asotin Creek Core Areas makes them vulnerable to extirpation from stochastic events, and increases the importance of maintaining connectivity between them.

The mainstem Snake River Basin and Clearwater River Basin is essential in enabling bull trout migration and facilitating genetic exchange between Core Areas. The lower Snake River provides essential connectivity for sub-adult and adult bull trout between the mid-Columbia and Clearwater basins, while the mainstem Clearwater River provides critical connectivity between Core Areas of the Clearwater River subbasin and the Snake River basin. Extending from below Ice Harbor Dam to the confluence of the Snake and Clearwater Rivers and up to Lewiston, Idaho, the Action Area contributes to the shared FMO area that is critical for supporting connectivity in the larger MCRU system. Shared FMO habitats of the lower Snake and Clearwater Rivers are important for these individuals to meet their critical overwintering, spawning migration, and subadult and adult rearing needs. Thus, these areas support the viability of bull trout populations by contributing to successful rearing and overwintering survival and dispersal among Core Areas.

9.7 Climate Change

Consistent with USFWS policy, our analyses under the ESA include consideration of ongoing and projected changes in climate. The term “climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2014a, pp. 119-120). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2014a, p. 119). Various types of changes in climate can have direct or indirect effects on species and critical habitats. These effects may be positive, neutral, or negative, and they may change over time. The nature of the effect depends on the species' life history, the magnitude and speed of climate change, and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2014b, pp. 64, 67-69, 94, 299). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change and its effects on species and their critical habitats. We focus in particular on how climate change affects the capability of species to successfully complete their life cycles, and the capability of critical habitats to support that outcome.

9.7.1 Climate Change and the Columbia River Basin

Climate change research for the larger Northern Rockies area predicts warmer springs, earlier snowmelt, and hotter, drier summers with longer fire seasons (Isaak et al 2015, p. 2540). In the Pacific Northwest, most models project warmer air temperatures, increases in winter precipitation, and decreases in summer precipitation (ISAB 2007, p. iii). Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the seasonal amount of snow pack diminishes, the timing and volume of stream flow are likely to change and peak river flows are likely to increase in affected areas. Higher air temperatures are also likely to increase water temperatures (ISAB 2007, p. 16).

Over the last century, average annual temperatures in the US have increased about 2 °F (0.2 °F per decade) over the last 50 years (USDA 2010, p. 3; Bonneville et al. 2017, p. 92). Winter temperatures have increased more than other seasons, and the daily minimum temperatures, typically occurring at night, have increased more than daily maximums. Models indicate that temperature increases would occur during all seasons, with the greatest increases projected in summer. Precipitation predictions are considered less certain, but most models project decreased summer precipitation and increased winter precipitation.

The variation in precipitation and temperature patterns from one year to the next, combined with the geographic complexity of the Basin, result in highly variable Columbia River flows from year to year (Bonneville et al. 2017, p.19). The Columbia River has an annual average runoff of approximately 200 million acre ft per year, with roughly 25 percent of that volume originating in the Canadian portion of the Basin (Reclamation 2016; Bonneville et al. 2017, p. 92). In its analysis of changing water temperatures in the lower Columbia River, the U. S. Environmental Protection Agency found that, since the 1960's, water temperatures in the mainstem Columbia and Snake Rivers have increased roughly 0.3 °C per decade (USEPA 2021, p. 73). Dams on the Columbia and lower Snake Rivers appear to have exacerbated summer water temperature warming associated with climate change (USEPA 2021, p. 72). August mean temperatures are expected to increase from near 22 °C currently to 23 °C by 2040.

9.7.2 Climate Change and Bull Trout

All life stages of the bull trout rely on cold water. Increasing air temperatures are likely to impact the availability of suitable cold-water habitat (Isaak et al. 2015, p. 2540; Dunham et al. 2014). For example, ground water temperature is generally correlated with mean annual air temperature and has been shown to strongly influence the distribution of many trout species (Rieman et al. 2007, p. 1557). Ground water temperature is linked to bull trout selection of spawning sites and has been shown to influence the survival of embryos and early juvenile rearing of bull trout (Rieman et al. 2007, p. 1553). Increases in air temperature are likely to be reflected in increases in both surface water and groundwater temperatures.

Bull trout require very cold (<10 °C) water for spawning and incubation (Dunham et al. 2014). Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change are related to shifts in timing, magnitude and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007, p. 6720). The increased magnitude of winter peak flows in high elevation areas is likely to impact the location, timing, and success of spawning and incubation for the bull trout and Pacific salmon species as well as juvenile survival. Low elevation river reaches are unlikely to provide suitably cold temperatures for bull trout spawning, incubation, and juvenile rearing under current temperature; therefore, the general impact of temperature and hydrologic changes may not be as extreme, or range constrictions as pronounced as what may occur in higher elevation streams. However, increasing mean summer temperatures are likely to interfere with successful migration or result in altered migratory timing or habitat use patterns for salmonid species (USEPA 2021, p. 74), altering forage availability for bull trout in shared FMO habitat. As climate change progresses and stream temperatures warm, thermal refugia will be critical to the persistence of many bull trout populations, as well as the salmonid species that currently provide a prey base.

Projected changes in climate may be expected to result in several impacts to bull trout and habitat including contraction of the range of bull trout; variable or elevated stream temperatures that reduce survival and reproduction; altered ground water exchange that limits egg development; and changed geomorphology that reduces presence or quality of spawning habitat (USFWS 2015a). In addition, increased or variable flows from extreme precipitation events, rain on snow and longer dry periods may increase scouring of spawning areas, reduce juvenile rearing capacity of habitat, and inhibit movements during summer low flow conditions (USFWS 2015a). Increased frequency and extended periods of wildfires may result in loss and fragmentation of habitat (USFWS 2015a).

There is still a great deal of uncertainty associated with predictions relative to the timing, location, and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007). For example, several studies indicate that climate change has the potential to impact ecosystems in nearly all streams throughout the State of Washington (Battin et al. 2007; ISAB 2007; Rieman et al. 2007; Isaak et al. 2015). In streams and rivers with temperatures approaching or at the upper tolerance limits for bull trout, such as occurs in the Walla Walla, Yakima, Umatilla and Snake Rivers, there is little, if any likelihood, that bull trout will be able to adapt to or avoid the effects of climate change/warming without connectivity to cooler waters. As bull trout distribution contracts, patch size (contiguous catchment area of suitable spawning/rearing habitat) decreases, and connectivity is truncated. Bull trout populations that may be currently connected will likely face increasing isolation (Rieman et al. 2007, p. 1553; Dunham et al. 2014). Due to variations in landform and geographic location across the range of the bull trout, it appears that some populations face higher risks than others. Bull trout in areas with currently elevated water temperatures and/or at the southern edge of its range may already be at risk of adverse impacts from current as well as future climate change.

10 EFFECTS OF THE ACTION: Bull Trout and Designated Bull Trout Critical Habitat

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

As described previously, the Project represents a second-tier action under the first tier framework programmatic for the PSMP. The first tier consultation envisioned that second-tier, site-specific consultations under the PSMP would be necessary to confirm that predicted quantities of dredged or deposited sediment in the PSMP are not exceeded, that potential effects to the bull trout or bull trout critical habitat are consistent with those considered under the PSMP, and that any incidental take of the bull trout would be addressed, as appropriate. In this section, the USFWS evaluates the site-specific details of the proposed action to determine the effects to bull trout are consistent with those considered under the PSMP given the site-specific details. The contents of the PSMP BO, including the analysis of effects to bull trout and its designated critical habitat are hereby incorporated by reference.

10.1 Insignificant and Discountable Effects to Bull Trout

Through the proposed action, bull trout may be exposed to one or multiple stressors as a result of project-related activities that are expected to result in effects that are insignificant or discountable. These activities are not likely to adversely affect bull trout because the effects are considered extremely unlikely to occur (discountable), will not be measurable or detectable (insignificant), or the effects will be beneficial. In this section, we consider both direct and indirect effects, including interrelated effects. Stressors that are not likely to adversely affect bull trout include: (1) onshore noise and surface operations; (2) entrainment, burial, or physical injury during dredging and disposal; (3) elevated underwater noise and disturbance; (4) physical loss or degradation of foraging and migrating habitat; (5) potential chemical contamination through re-suspension and redistribution of contaminants; (6) potential chemical contamination through through spillage or leakage of fuels, oils, or greases; (7) wake generation; and (8) overhead cover.

The pathway of effects to bull trout from each of these stressors was thoroughly described in the PSMP BO (pp. 52 - 74). The USFWS has determined that effects to bull trout from onshore noise and surface operations; entrainment, burial, or physical injury during dredging and disposal; potential chemical contamination through through spillage or leakage of fuels,oils, or greases; wake generation; and overhead cover of barges are consistent with the effects to bull trout described in the PSMP; thus, we provide a short summary with our determination of effects to bull trout. The PSMP BO determined there was insufficient detail to thoroughly evaluate project-specific effects to bull trout resulting from instream noise and disturbance; loss or degradation of foraging and migrating habitat; or potential chemical contamination. We provide a more detailed analysis on the effects to bull trout for each of these stressors.

Onshore Noise and Surface Operations - Any shoreline or upland staging areas or other ancillary project-related activities (e.g., securing supplies, transporting personnel) are expected to take place in previously developed or heavily disturbed sites, and are expected to have no effect on bull trout. Surface operations include the use of boats, tug boats, and barges, as well as the equipment used to perform redd surveys, conduct dredging and disposal (does not include the actual dredging and disposal), and travel to and from the dredging and disposal locations. We expect the minor disturbance associated with boats, tugs, and barges are likely to be indistinguishable from the existing shipping, boating, and shoreline activities that currently occur in the Action Area. Likewise, surface noise and disturbance from operation of the dredging equipment is expected to create a minor amount of disturbance, which is likely to be masked by the baseline of disturbance throughout the lower Snake River and avoidable due to the overall size of the Snake River relative to the dredging operation. Due to the fact that most dredging will likely occur using only one dredge plant (Tice, B., in litt. 2022b), we expect most Project-related dredging disturbance will be highly localized, increasing in size wherever additional dredge plants are used. However, due to the low magnitude and intensity of the disturbance comparable to the existing conditions, we expect effects to bull trout from surface operations to be insignificant.

Entrainment or Physical Injury During Dredging - The USFWS assumes that dredging will be completed using a clamshell bucket, based on previous dredging efforts and as described in the BA (pp. 15, 66-67). Clamshell buckets are not likely to kill, injure, or entrain bull trout under typical operating conditions because they descend to the substrate in the open position and ascend to the surface in the closed position. Clamshell buckets do not produce the tractive force that would draw fish to the dredge and any bull trout that may be present are expected to be able to avoid the buckets during descent and ascent to avoid injury. The USFWS considers it very unlikely that bull trout near the riverbed could be injured or killed as the bucket descends and contacts the substrate, or that they could be entrained in the bucket as it closes prior to ascending. Likewise at the disposal site, the USFWS considers it very unlikely that bull trout in the immediate area could be engulfed, injured or killed as barge loads are released and the materials descend through the water column, or by equipment during final contouring operations.

The highest probability of bull trout exposure to dredging operations is expected to occur just as operations begin at a given work site. However, dredging and disposal is expected to cause considerable splashing, noise, and movement of equipment both in and out of the water each time a bucket is dropped into the water and pulled back to the surface, or as the barge is ready to unload the dredged material. The disturbance caused by operating the mechanical equipment is likely to elicit a startle response in any bull trout in the vicinity of the dredge and also discourage more distant fish from moving toward the dredge site. Further, bull trout adults and subadults not have any of the characteristics that make fish vulnerable to burial; that is small size, limited swimming ability, and tendency to physically rest on the stream bottom (Drabble 2012; Nightengale and Simenstad 2001). Adult and subadult bull trout have relatively high swimming speeds that enable them to rapidly escape when they are alarmed, and they do not rest on the stream bottom, although they may stay near cover on the bottom. Nonetheless, the USFWS expects that any bull trout that may be present would avoid the immediate area of equipment once operations are underway and would be able to locate suitable avoidance habitat, as project implementation will occur using a single dredger, leaving alternative habitat available for local movement and avoidance. Given the fact that bull trout are likely to respond to the predredging noise and vacate the dredging area into similar and available alternative habitat, and are unlikely to be entrained or buried during dredging operations, we expect the in-water construction would have insignificant effects on the bull trout.

Spillage or Leakage of Fuels, Oils, Greases - Operation of equipment requires the use of fuel and lubricants, which, if spilled into the channel of a waterbody or into the adjacent riparian zone, can injure or kill aquatic organisms. Petroleum-based contaminants contain poly-cyclic aromatic hydrocarbons (PAHs), which can be acutely toxic to salmonids at high levels of exposure and can cause lethal and sublethal chronic effects to other aquatic organisms (Neff 1985). The risk of chemical contamination is reduced due to Impact Minimiaztion Measures that avoid introducing chemical contaminants to the water, including fueling at existing commercial fuel docks where spill prevention systems are in place, assuring equipment is inspected for leaks and cleaned prior to any instream work, and developing and maintaining a spill prevention and control plan. Due to the implementation of impact minimization measures that minimize or avoid chemical contamination to water, we have determined that effects to bull trout from potential spillage, or leakage of fuels, oils, or greases is discountable.

Generation of Wakes - Project-related wake action may occur directly as a result of wakes produced by the various vessels of the barge plant when moving between dredging and disposal sites and when transporting the plant between the Ice Harbor lock approach and Project operations in Lower Granite Reservoir. Wakes caused by commercial traffic facilitated by the proposed action are considered an interrelated effect. Bull trout are not expected to be directly harmed by wakes because adult and subadult bull trout are capable of swimming against the waves. Boat-generated wakes have the greatest potential to cause bank erosion that increases turbidity or reduces near-shore habitat. These impacts are most likely to occur where the river channel is narrow, where boat use is regular and concentrated close to shore (especially where shorelines contain highly erodible material or lack protective vegetation), and where river systems are not subject to naturally high erosive flows (McConchie and Toleman 2003). However, the banks of the Snake and Clearwater Rivers are generally not conducive to erosion from barge wakes because the channel is relatively wide, erodible materials are removed by annual floods, barges do not travel close to shore (except when berthing), and the shorelines along the river are predominantly composed of coarse rocks that are too large to be moved by wave action. Vessel passage may generate wakes that cause brief episodes of turbidity along shorelines with deposits of fine sediments, as described by Whitfield and Becker (2014), but episodes of turbidity caused by barge wakes are likely to persist for well under an hour due to the river current. Turbidity levels from wakes is likely to be limited in spatial extent and duration

(Schroeder 2014) and are not expected to adversely affect bull trout because the level of turbidity is unlikely to exceed the threshold where reductions in feeding rates have been observed at 1-hour exposures (see Table 9). Due to the low potential for direct injury to bull trout, low potential for erosion, and the fact that any exposure to turbidity would be for a duration or level below that known to cause adverse effects to bull trout, we expect direct and indirect effects to bull trout from wakes to be insignificant.

Overhead Cover - Moored vessels, including barges and tugs supporting project operations or mooring of vessels that utilize the navigation channel, may indirectly affect bull trout by blocking sunlight from reaching the water column underneath and altering currents near the surface, potentially providing a predatory advantage to species that prey on bull trout, resulting in increased predation risk or reduction in bull trout native prey species by providing cover in which to avoid detection. While some local non-native predators have a strong affinity to in-water structures, including those recognized as common predators of subyearling salmonids in the Columbia River drainage (Carrasquero 2001), barges lack the physical habitat complexity that provides hiding places found among the pilings that often support in-water structures and, despite the shadow moored vessels provide, they are not considered comparable to fixed structures supported by piles. The transitory use of barges during dredging and disposal operations and subsequent sporadic mooring of vessels is not likely provide a consistent or predictable environment that would enable predatory fish to congregate. Likewise, neither would the transitory movement of commercial vessels facilitated by the maintenance of the navigation channel, an interrelated effect. Given the fact that the type of overhead cover produced by or as a result of the proposed action is not considered comparable to the structure of predictable cover that results in predatory advantage to species that may prey on bull trout, we expect effects to bull trout from project-related overhead cover to be insignificant.

Elevated Underwater Noise - Bull trout in the Action Area may be exposed to elevated underwater noise associated with dredging, disposal, and the use of boats, tugs, and barges. The potential impacts to bull trout from elevated underwater noise are well-described in the PSMP BO (pp. 64-66). The USFWS has determined that the dredging operations are unlikely to exceed sound pressure levels (SPLs) capable of causing direct injury or death (i.e., single strike sound exposure levels of 183 $dB_{SEL)}$, but may elicit behavioral effects at the highest range. The USFWS has previously determined that elevated underwater noise may induce behavioral effects to bull trout at 150 dB but that the degree to which behavioral effects result in injury or death, or create a likelihood of injury or death through significant modification of normal behaviors, is dependent on the location, duration, and species' normal use of the area (Teachout 2010, pp. 8-9).

The biological assessment on the PSMP anticipates sound pressure levels associated with channel maintenance to range from 112 to 160 decibels (dB) but does not describe how the range was determined, the distance from source, or the type of material under consideration, which is important because the sound produced from bucket contact with larger substrate is louder than the sound of contact with smaller substrate. However, the range described is similar to Dickerson et al. (2001), who found the peak sound level of 124 dB at 150 meters from bucket dredging in Cook Inlet, Alaska. Assuming sound levels attenuate at a rate of 4.5 dB per doubling distance (WSDOT 2020, p. 7.32), the Cook Inlet operations would have produced sound levels approximating 146.5 dB at a distance less than 5 meters from the dredge. The USFWS assumes peak noise levels of 160 dB at the Ice Harbor lock approach where the bucket strikes larger substrate, attenuating with distance, but assumes underwater noiselevels are not likely to exceed 150 dB elsewhere, based on the Cook Inlet data.

We do not expect individual response to elevated underwater noise associated with dredging to significantly interfere with normal behaviors to the point of causing a likelihood of injury or death. Dredging disturbance will be restricted to sites already impacted by human disturbance (i.e., dams, active navigation routes experiencing boating and barge traffic, and berthing ports), would be confined to the immediate area by the operational use of a single barge group, and will be temporary, occurring over one to several days at a time. We expect noise from vessels or equipment (outside of bucket striking substrate) will be indistinguishable from existing boating and barge traffic. Fish exposed to these sound levels associated with dredging might display a startle response and are expected to flee the immediate area. Alternative habitat is available outside of the dredging footprint, including within the lateral channel adjacent dredging operations. Consequences to bull trout from such a response occur in the form of an energetic cost and altered feeding while they seek suitable habitat, but Carlson et al. (2001) found that fish displaced by dredging in the Columbia River resumed normal positions and normal behavior within a short time after moving. We expect bull trout in the Action Area will move away from dredging disturbances into nearby similar habitat without significant energetic expense and without significant disruption to normal foraging due to their age class (adult and subadult) and similarity of habitat within the Action Area (Carlson et al. 2001). Through our analysis, we have determined that effects to bull trout from elevated underwater noise associated with dredging are likely to be insignificant due to the localized, temporary nature of the disturbance located in an area that already experiences elevated noise levels, and because individual response to sound pressure levels are not expected to cause significant disruption in normal foraging, migrating, and overwintering behavior.

Likewise, we expect effects of elevated underwater noise associated with transportation between dredge and disposal sites to be indistinguishable from background barge and vessel noise; thus, having insignificant effects to bull trout. Although the disposal site likely experiences lower human disturbance and has a much lower ambient noise level compared to the dredging sites, projet-related disturbance is expected to be minor compared to dredging operations (not expected to exceed 150 dB), temporary while the barge unloads (approximately 20 minutes; USFWS 2014a, p. 66), and highly localized due to the shoreline location (Figure 7) and by the use of a single barge group. Underwater noise is expected to be comparable to background conditions comprised of vessels traffic that currently moves through the area, though somewhat more stationary, and we expect bull trout to be able to temporarily move away from elevated underwater noise to nearby similar habitat. Migratory individuals will have ample opportunity to avoid the disturbance, given the size of the river relative to the shoreline disposal site, and are expected to experience no significant impairment to movement.

Through our analysis, we have determined that effects to bull trout from elevated underwater noise associated with dredging are likely to be insignificant due to the localized, temporary nature of the disturbance, location in an area that already experiences elevated noise levels, and because individual response to sound pressure levels are not expected to cause significant disruption in normal foraging, migrating, and overwintering behavior.

Loss or Degradation of Foraging, Migrating, and Overwinter Habitat - Potential impacts to bull trout foraging and migrating habitat is well-described in the PSMP BO, but the PSMP BO envisioned future site-specific consultation would be needed to fully evaluate potential effects. The Corps proposes to dredge approximately 100 acres of shallow habitat and to cover 23 acres of existing mid-depth habitat (mostly 20 to 60 ft deep) with dredged materials, maintaining shallow habitat in the dredging areas and resulting in shallower mid-depth habitat at Bishop Bar. These areas currently represent varying degrees of suitability as rearing habitat for anadromous salmonids, as suitability is largely determined by depth, substrate type, and location relative to the shoreline. This section discusses the physical loss or degradation of habitat due to the removal of materials from the dredging sites and placement at the disposal site.

The most important habitat attributes to bull trout that may occur in the Action Area are the presence of abundant food items, including juvenile and subadult anadromous salmonids and other fish, and an unobstructed river corridor that allows movement. Likewise, many of the bull trout prey species depend on an unobstructed river corridor, as well as abundant benthic organisms as food, which are supported by the sandy and silty substrates within the dredging areas (Bennett and Shrier 1986). Dredging will result in a more uniform riverbed, but it would still be composed primarily of cobble at the Ice Harbor approach and sand/fines at the remaining sites. The change in depth of these sites due to the dredging and disposal operations would not be expected to substantially reduce the suitability of these habitats or impair passage for migrating bull trout or other salmonids. The disposal area would be comprised of uniform, sand-dominated substrate, sloping (10 percent), mid-depth habitat resembling a sand bar with features optimized for resting and rearing of outmigrating salmonids (BA, p. 60); thus maintaining suitability as rearing and migrating habitat for both bull trout and other salmonids. Because the rivers in the Action Area are very wide, adjacent habitats are expected to be available during dredging activities, and bull trout upstream or downstream movement should not be impaired.

We expect the primary impact to bull trout forage is expected to be through the reduction in benthic invertebrates; however, the footprint of the dredging and disposal areas are relatively small compared to the size of the mainstem rivers and locally disturbed areas are expected to recolonize within a few weeks or a few months, depending on the species. The alteration may have little effect on bull trout because benthic invertebrates are not a significant part of the diet of bull trout or of native salmonids, though other bull trout prey species may rely on them. Regardless, given the large portion of the river channel outside of the Project footprint, we do not expect the loss of benthic invertebrates to significantly alter feeding opportunities for salmonids, nor for bull trout. Even if the benthic invertebrate population in the disturbed area is being used by bull trout prey species, the disruption to this food source will cover a relatively small area, and will be limited to a few months after activities are completed.

The Corps has previously utilized dredge spoils to create shallow water habitat, targeting fall Chinook but also benefit other salmonids, including bull trout that might forage in shallow areas. The decision precludes improvements to habitat important to fall Chinook, but we do not expect the decision itself to significantly impact bull trout, as bull trout utilize a number of prey items, many of which are not dependent on the availability of shallow water benefitting primarily fall Chinook (i.e., habitat less than six ft deep) habitat. Despite a net reduction in 6-foot or less habitat in the Port of Clarkston berthing area, the berthing area is highly disturbed by commercial activity and provides marginal value to fall Chinook (Mital, J., pers. comm. 2022). Under the PSMP, dredge spoils may be disposed of upland or in-water for a variety of uses that offer no benefit to listed species (USFWS 2014 a, Table 1, p. 5); thus, the USFWS does not consider the decision to forego creation of shallow water habitat a significant deviation from the PSMP, and is expected to have no significant ramifications to bull trout forage base. The Corps is committed to investigating and pursuing opportunities to enhance shallow-water rearing habitat (BA, p. 20), and future disposal of dredged material in Bishop Bar may ultimately create additional shallow water habitat (BA, p. 17).

Due to the fact that the Project is not expected to impede migration, significantly alter the suitability of habitats for rearing and migrating salmonids, or impact benthic production enough to have significant impact on the availability of bull trout foragebase, we expect the effects to bull trout from Project-related impacts to foraging and migrating habitat to be insignificant.

Re-suspension and Redistribution of Contaminants - As described in section 9.2, *Condition of Habitat in the Action Area*, of this opinion, contaminants associated with urban development, roads and vehicles, stormwater discharge, and dam and levee operations (in additional to collective effects from upstream agriculture and irrigation, mining, foresty, and grazing) that are in solution or suspended in the water column are transported on water currents or settle onto substrates, contributing to degraded water quality conditions. Contaminants that may be present in the Action Area and include mercury, copper, and other metals; chlorinated pesticides and their degradates (DDT, DDD, DDE), polychlorinated dibenzo-p-dioxins and furans, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), PAHs, and many others (see NMFS 2021). Contaminants bound to sediments may be resuspended in the water column during dredging for roughly the same distance and duration as the suspended sediment (see section 10.2.1, *Effects to Bull Trout from Turbidity and Suspended Sediments*, of this opinion), and a fraction of the resuspended contaminants are likely to separate from the sediment particles and remain in the water column as dissolved or suspended chemicals. Potential contaminants may be redistributed during transportation from the dredging site to the disposal site where they will be dumped directly from the barge. Most of the potential contaminants of concern bind to the finest particles (i.e., silts), which are more likely to move over time with river flows if left exposed to the river currents or erosive forces.

Sediments proposed for dredging were screened for the presence of contaminants in 2019, following procedures by Corps et al. (2013) and Michelsen (2011). These screening procedures trigger bioassays and intensive sediment sampling and chemical analyses if contaminants are found at specified concentrations, or “screening levels” that are set below state and Federal water quality standards. Using an approved sampling design and currently available protocols (Corps 2020, p. 6), the Corps tested for the presence of potential contaminants in the sediments proposed for dredging near the confluence of the Snake and Clearwater Rivers, but testing was not required at the Ice Harbor site due to the large substrate size. Most of the results were either below instrument detection limits or below screening levels. Screening level exceedances for 4-methylphenol in two of the Port of Clarkston sampling locations triggered bioassay testing to determine the potential toxicity of sediments to benthic/epibenthic organisms, but all tested sediments passed (i.e., were found not to result in increased toxicity to test organisms relative to reference and control sediments), and sediments were determined to be suitable for open-water disposal (Corps 2020, p. 6).

There is some uncertainty in the potential exposure and risk to the aquatic environment from 4-methylphenol in turbidity plumes, despite that the contaminant passed the bioassay tests that are designed to indicate toxicity to the aquatic environment. In addition, despite the fact that none of the potential contaminants tested exceeded existing regulatory thresholds or other established criteria, bioaccumulation and related effects are of concern, as pollutants can reach concentrations in higher trophic level organisms (e.g., salmonids) that far exceed ambient environmental levels (Meador et al. 2004; Meador et al. 2006; Meador et al. 1995). And finally, there remains uncertainty in the final redistribution of contaminants within the Action Area.

As a conservative measure to avoid any bioavailability and redistribution of potential contaminants, the Corps has committed to conduct dredging and disposal in steps. The first step will place the larger rocks and cobbles from the Ice Harbor Lock downstream approach at the bottom of the disposal site to provide underwater structure. Sediments from the Port of Clarkston, where screening criteria was exceeded, and other areas which contain the majority of fines and other constituents that may be of concern will be placed within the underwater structure, followed by the Port of Lewiston and other areas that contain coarse sand, to provide a "cap" to cover any potential contaminants from the substrate/water interface (Tice, B., in litt. 2022d). The Corps has committed to monitor the disposal site during dredging, post-dredging, following the first spring run-off, and after summer high flows, using hydrographic surveys, to assure long-term stability of the structure.

The cap will minimize the potential for sediment transport, particularly fine sediments to which most metals or other potential contaminants of concern are likely to be bound, but will not make sediments from the Port of Clarkston completely unavailable, as benthic organisms that make daily vertical migrations into the substrate will continue to be able to access the disposal pile. Some contaminated sediments may be transported to the surface during these migrations or through contaminant loading in the tissue of benthic organisms. Although no longer available to predation by salmonids occupying shallow water habitat, due to the transport of dredge material from shallow water habitat to mid-elevation habitat, there is likely to be some predation on these benthic organisms by species, including native salmonids, that forage in deeper habitats. Bull trout may later consume contaminants bound to the tissue of these fishes, but bull trout primarily forage in shallow water habitat and we do not expect a significant difference in the rate bull trout ingest contaminant-loaded tissue prior to versus following project implementation. Sediment that forms the cap will continue to be available to river flows, some of which may contain contmainants, but we expect concentraions will largely be at or below screening levels, based on the Corps' analysis (Corps 2020). Although the baseline condition is one where most sediments entering the reservoir remain, that is, they do not wash downstream of Lower Granite Reservoir, the sediment cap is an additional, project-related action that will further reduce the potential for downstream sediment transport that may otherwise occur in a natural system.

Based on current information regarding chemical effects to bull trout and other salmonids, the Project may expose bull trout to re-suspended contaminants that are bound to dredged sediments, but not at levels that are known to incur adverse effects. As a precautionary measure, the Corps will place the materials most likely to introduce concern at the bottom of the Bishop Bar disposal site and under a "cap" of sand to reduce bioavailability and subsequent dispersal that will be monitored; thus reducing risk over the long-term. Based on the low likelihood of exposure to contaminants at levels that would result in adverse effects, we expect effects to bull trout resulting from exposure to resuspended and redistributed dredged sediments to be insignificant.

10.2 Adverse Effects to Bull Trout

Bull trout may experience adverse effects as a result of elevated turbidity or suspended sediments. The Proposed Action includes a number of impact minimization measures (BA, p. 20) to minimize adverse effects to bull trout as a result of elevated turbidity or suspended sediments, and the following analysis assumes those measures will be implemented during these activities. This Opinion analyzes the likelihood and magnitude of potential effects, taking into consideration those minimization measures.

10.2.1 Effects to Bull Trout from Turbidity and Suspended Sediments

The Corps anticipates dredging a minimum of 257,910 cy of sediments from the Federal navigation channel at the downstream approach to Ice Harbor Dam prior to moving up to the Lower Granite Reservoir, where they will dredge the confluence of the Snake and Clearwater Rivers in the navigation channel and at the Ports of Clarkston, Washington and Lewiston, Idaho. Sediment accumulations from the 2022 spring runoff are likely to contribute additional materials that will also be removed during dredging, but the total dredged quantity will not exceed 500,000 cy (Tice, B., in litt. 2022a). All dredged materials (i.e., "spoils") will be deposited at Snake RM 118 at Bishop Bar. Project implementation will most likely be facilitated by a single dredge plant, previously defined as a barge with a crane, two tugs, and three barges for transporting sediment to the disposal area, but more than one and up to three dredge plants may be necessary when needed to ensure all dredging is completed within the Project work window. Dredging operations could take the entire 77- day work window from December 15, 2022 to March 1, 2023. The Corps has envisioned that they would need to dredge approximately 3,350 cy of material per day to dredge 257,000 cy, but may require between 6,000 and 7,200 cy per day depending on additional accumulation during 2022 spring flows.

Dredging approximately 2,150 cy of material from the mid-channel area at the Ice Harbor Dam downstream approach, is expected to be completed in a single day, given the barge capacity of 3,000 cy (BA, p. 15). Following the removal of dredged materials, the barge would travel approximately 109 miles upstream to the Bishop Bar bench area to place the spoils, occurring up to 20 minutes (USFWS 2014a, p. 53). The barge group would then move upstream to the Snake River and Clearwater River confluence dredge sites where dredging may occur for up to 24 hours per day (1848 hours) and affect large portions of sandy, shallow water to mid-depth habitats from the shoreline to the thalweg and span up to 50 percent of the width of the river channel (Figure 4). After being loaded, each barge would travel approximately 24 miles downstream to the Bishop Bar location to deposit its load before returning to the active dredge site. We assume activities at the disposal site would be periodic, occurring for up to 20 minutes roughly every 8 hours (USFWS 2014a, p. 53). Dredging and disposal operations have the potential to release fine sediments to the water column, creating turbidity plumes that carry downstream, typically decreasing with distance from source. All of these activities would disturb and suspend a significant volume of benthic sediment. In the immediate vicinity of each active work site and for some distance downstream and laterally within the river channel, turbidity would substantially exceed natural background levels. These turbidity plumes may adversely affect bull trout in the area.

The USFWS' PSMP BO provides a detailed analysis of the effects of elevated turbidity and suspended sediments on bull trout (USFWS 2014a, pp. 53 – 55) as well as a detailed explanation of the USFWS' analytical framework (Biological Effects of Sediment on Bull Trout and Their Habitat - Guidance for Evaluating Effects (USFWS 2010c)) for analyzing effects of sedimentation on bull trout (pp. 55 – 56), both of which are summarized here. The analytical framework is based on the research of Newcombe and Jensen (1996). For our analysis, we rely on the analytical framework to analyze effects to bull trout from the proposed action, consistent with the PSMP under which the proposed action is occurring, as well as monitoring data during both the 2005/2006 dredging and the most recent 2014/2015 dredging. For this analysis, we assume that dredging activities and water quality monitoring will mimic procedures followed during the 2014/2015 dredging event, as indicated in the BA (p. 16).

Table 7 displays the severity of effect (SEV) levels that indicate adverse effects to bull trout (USFWS 2010c). Effect calls for habitat are also provided to assist with analyses of effects to individual bull trout. Bull trout in the Action Area are expected to be subadult and adult fish. For those life stages, for example, a severity level of 6 indicates an adverse effect to bull trout in the Action Area based on the fact that SEV 6 is associated with moderate physical stress (Newcombe and Jensen 1996 *in* USFWS 2010c), a sublethal effect. A severity level of 8 indicates major physiological stress, and severity levels of 9 or higher indicate lethal and paralethal effects (USFWS 2010c).

Table 7. Severity of Effects (SEV) levels that indicate effects determinations to bull trout, including habitat effects determination.

	Severity of Effect (SEV)	**ESA Effect Call**
Egg/alevin	1 to 4 5 to 14	Not applicable - alevins are still in gravel and are not feeding. LAA - any stress to egg/alevin reduces survival
Juvenile	1 to 4 5 to 14	NLAA LAA
Subadult and Adult	1 to 5 6 to 14	NLAA LAA
Habitat	1 to 6 7 to 14	NLAA LAA due to indirect effects to bull trout

10.2.1.1 General Impacts to Bull Trout From Exposure to Elevated Turbidity and Suspended Sediments

Quantifying potential effects of sediment and turbidity on bull trout is complicated by a number of factors: (1) turbidity and suspended sediments attenuate at a rate dependent on the quantity and physical and chemical properties of the sediments in consideration of the river flow; (2) impacts to individual fish depends on the concentration and exposure duration, particle size and constituents of the sediments, species characteristics, and habitat use at the affected site; and (3) individual response patterns vary, where some individuals may avoid the plumes by moving away while others may settle to the river bottom to wait out the plume.

Table 8. Summary of Expected Adverse Effects to Fish Resulting from Elevated Sediment Levels.

Physiological	Behavioral	Habitat
Gill trauma; increased coughing; increased respiration rate[1]	Alarm reaction; Avoidance; Abandonment of cover[1]	Reduction in spawning habitat
Osmoregulation[1]	Territoriality[1]	Effect on hyporheic upwelling
Blood chemistry (increase in levels of stress hormones)[1]	Reduction in feeding rates and feeding success; increased exposure to predation[1]	Reduction in benthic invertebrate habitat
Reduced fitness; impaired growth and reproduction; increased susceptibility to disease; delayed hatching; reduced fish density; mortality[2]	Impaired homing and migration[1]	Damage to redds

(USFWS 2010c; Bash et al. 2001; Anderson et al. 1996; Newcombe and Jensen 1996)
[1] Behavioral and sublethal effects (USFWS 2010c)
[2] Lethal and paralethal effects (USFWS 2010c)

Elevated turbidity and suspended sediments may cause injury or harm to bull trout through a variety of physiological, behavioral, and habitat-related mechanisms (Table 8): (1) injuring or killing fish from trauma or stress; (2) harming fish indirectly by reducing their growth rate or resistance to disease; (3) interfering with reproductive potential; (4) modifying fish behaviors such as feeding, migration, and movement patterns; and (5) reducing the abundance of food organisms available to the fish (Newcombe and MacDonald 1991; Bash et al 2001; Anderson et al. 1996; Newcombe and Jensen 1996). These potential adverse effects may be correlated to projected project turbidity concentrations and duration (Table 9). The turbidity concentrations and duration were determined from the Corps' 2005/2006 turbidity monitoring data for similar type dredging and disposal activities (USFWS 2014b, BA) and are considered suitable for our analysis.

Table 9. Potential adverse effects on juvenile and adult salmonids associated with exposure to elevated suspended sediment levels1 over given time periods (after Newcombe and Jensen 1996 and USFWS 2010c).

Description of Effect	NTU Level (TSS)	Duration
Behavioral: Alarm Reaction, Avoidance Response, Abandonment of Cover	62 (148) 41 (99) 17 (40) 8 (20)	Instantaneous Up to 1 hour Up to 3 hours Up to 7 hours
Sublethal: Short- to Long-Term Reduction in Feeding Rates or Success, Moderate to Major Respiratory or Physiological Stress, Impaired Homing, Moderate Habitat Degradation, Poor Condition	461 (1097) 372 (885) 145 (345) 70 (167)	Instantaneous Up to 1 hour Up to 3 hours Up to 7 hours
Lethal / Paralethal: Reduced Growth Rates, Delayed Hatching, Reduced Fish Densities, Severe Habitat Degradation, Direct Mortality	9251 (22026) 3403 (8103) 1252 (2981) 461 (1097)	Instantaneous Up to 1 hour Up to 3 hours Up to 7 hours

[1] Salmonids can be adversely affected by total suspended sediments (TSS, measured in mg/L), but monitoring often evaluates turbidity which is measured in Nephelometric Turbidity Units (Schroeder (2014, p. 2). determined that the dredging plume modeling data showed a ratio of 2.4 mg/L TSS to 1 NTU; or NTU levels roughly equivalent to 0.42 reported TSS levels.
Source: USFWS 2014b, pp. 40 – 41.

In bull trout and other salmonids, excessive turbidity and suspended sediments can elicit a number of physiological responses (i.e., gill flaring, coughing, increase in blood sugar levels) that may affect survival, growth, and behavior of salmonids and stream biota upon which they feed (Harvey and Lisle 1998). The severity and magnitude depend on site specific conditions and exposures where injury increases with exposure duration and concentration of turbidity/ suspended sediments and decreases with particle size. Although suspended sediment has the potential to injure or kill fish, the typical response of salmonids to increasing amounts of suspended sediment is to move in an attempt to avoid the sediment (Bash et al. 2001; Robertson et al. 2006; Servizi and Martens 1992).

With this behavior pattern, we expect subadult and adult bull trout, which are capable of swimming against the current in a river, can often escape plumes of suspended sediment if cleaner waters are available nearby. However, some may remain within the plume, experiencing decreased foraging efficiency through reduced visual acuity and reactivity, and resulting in reduced fitness and fecundity. In some systems, salmonids thrive in naturally turbid conditions, potentially a result of the ability to use turbidity as cover from predators. Research has shown increased foraging in moderate turbidity, likley taking advantage of reduced vulnerability to predators (Gregory and Northcote 1993). Suspended sediments may also affect social behaviors (i.e., schooling) (Berg and Northcote 1985).

10.2.1.2 Impacts to Bull Trout from Excessive Sedimentation of the Riverbed and Resulting from Episodic Turbidity from Moving Vessels

Another effect from turbidity and suspended sediments is when the particles settle and contribute to local sedimentation of the riverbed. Sedimentation can cause a number of adverse effects to salmonids, including displacing potential prey species (Spence et al. 1996), negatively influence the exchange of streamflow and shallow alluvial groundwater, and generally depress riverine productivity (Newcombe and Jensen 1996; NMFS 2004b, p. 19). Considering the water volume, flow characteristics, and existing habitat conditions of the Snake River below the dredging and disposal sites, the USFWS does not expect that any adverse effects to bull trout would occur due to excessive sedimentation of the riverbed downstream of the dredging.

Dredging may indirectly enable barge traffic that can cause brief episodes of increased turbidity near the shore from wakes generated by moving vessels. Turbidity caused by wakes would be limited to near-shore areas that have deposits of fine sediment. The duration and frequency of turbidity increases from barge wakes is unlikely to rise to a level that would adversely affect bull trout.

10.2.1.3 Impacts to Bull Trout at Ice Harbor Dam

As described in the BA (p. 70), the substrate composition at Ice Harbor downstream lock approach is gravel and cobbles between 2 and 6 inches in diameter, and mostly free of fines. Due to the size of the materials to be dredged and the flow conditions of the site, it is expected that minimal amounts of fine-grained sediments would be liberated during the dredging operations. Only minor amounts of downstream turbidity would be expected and any turbidity plumes would quickly dissipate considering the water volume and flow characteristics of the site. Water quality monitoring during the 2015 dredging operation showed 100 percent compliance with Washington State Water Quality Standards of 5 Nephelometric Turbidity Units (NTUs) above background station readings at both the 300-foot and 900-foot monitoring stations downstream of the Ice Harbor dredging across 142 hours of dredging (BA, p. 71). We expect background turbidity is less than 5 NTUs, most likely between 2 and 4 NTUs (BA, p. 57); therefore, we expect Project-related turbidity would be no more than 7 to 9 NTUs, decreasing with distance from source. We expect that, at a dredging rate of 3,000 cy per 8-hr shift, the Corps can dredge the 2,150 cy from Ice Harbor in less than 6 hours.

We expect few bull trout to be present near Ice Harbor Dam during project activities, especially if dredging occurs during the day when bull trout are more likely to be associated with deeper waters. Bull trout that might be present near the dredging area are likely to move away from the area in response to the substantial amount of splashing that preceeds the actual dredging operations, an example of a startle response, thereby reducing the number that may be present upon commencement of dredging operations. Bull trout will be able to avoid the dredging footprint, estimated at approximately 225 ft wide based on previous operations at that site (USFWS 2014b, p. 35) because the Snake River measures approximately 1,200 ft wide at that location, which provides abundant avoidance habitat. In the unlikely event there is some localized turbidity and one or more bull trout remain in proximity to the dredging operation, we expect turbidity will last less than 6 hours and produce less than 9 NTU,which is not expected to rise to a level of causing adverse behavioral effects to bull trout (Table 9). Given the small dredging footprint compared to available habitat, short duration of operations at Ice Harbor, and minimal amount of sediment production anticipated, we expect impacts to bull trout from sediment and turbidity at the Ice Harbor Dam lock approach will be insignificant.

10.2.1.4 Impacts to Bull Trout at the Confluence of the Snake and Clearwater Rivers, the Berthing Ports of Clarkston and Lewiston, and the Disposal Site at Bishop Bar

The PSMP BO (pp. 57 – 59) discussed suspended turbidity effects on salmonids in general, and bull trout in particular. The information, taken from the USFWS' 2014 biological opinion on the 2014/2015 dreging event (USFWS 2014b, pp. 41-43) and updated as appropriate with recent monitoring from the 2014/2015 dredging event, is summarized as follows:

- The average background turbidity levels in the Snake and Clearwater Rivers during the winter dredging period in 2005 and 2006 was less than 5 NTU, with median values ranging from 2 to 4 NTUs in the Snake River (BA, p. 57). Data indicates that background turbidity was lowest at the confluence of the Snake and Clearwater Rivers and increased farther downstream in the Snake River. Background levels have not been updated in recent years, and are assumed to be no more than 5 NTU across the Action Area.
- During the 2005/2006 dredging at the Port of Clarkston, turbidity levels exceeded standards (greater than 5 NTU above background, which is the point of compliance for Washington State water quality standards) at both the deep and shallow monitoring probes and at both the 300-foot and 600-foot stations by up to 5.84 NTU (10.84 NTUs above the background level, totaling 15.84 NTUs in the water column) and up to 35 percent of the time. Water quality monitoring during the 2014/2015 dredging event found turbidity levels exceeded standards by an average of up to 5.8 NTUs (at Lewsiton, Idaho), although the exceedance lasted only one hour. The maximum exceedance hours were at Clarkston, Washington, where turbidity standards were exceeded by an average of 3.8 NTUs (8.8 NTUs above the background level, totaling 13.8 NTUs in the water column) for less than 6 percent of the time in the shallow water probe at the 900-foot station. During previous dredging and disposal efforts, turbidity levels occasionally ranged from 6 to 15 NTUs above background for several hours at a distance of 900 ft downstream. The majority of the time during dredging activities, turbidity remained within 5 NTU over background (up to 10 NTU total).
- Based on the data collected during the 2005/2006 and the 2014/2015 dredging events, and the estimated levels and duration that would cause behavioral, sublethal or lethal effects to salmonids or bull trout; it is expected that turbidity levels within 900 ft of a dredge would increase to levels that will cause behavioral responses (alarm, avoidance,

abandonment of cover) in adult and subadult bull trout that are within the turbidity plume, and potentially higher turbidity levels that cause sublethal effects, such as reduced feeding, physiological stress, impaired homing, etc. (Table 9).

- Previously, the USFWS ran the Newcombe and Jensen (1996) analysis using the 2005/2006 monitoring data for turbidity levels that exceeded the 5 NTU threshold. Although the 2014/2015 turbidity monitoring found exceedances were more infrequent, the 2005/2006 monitoring data provides a conservative scenario against which to analyze potential project-related effects to bull trout. At both the 300 ft and 600 ft monitoring stations, increased turbidity levels resulted in SEV of 3 to 6. These SEV levels indicate behavioral and sublethal effects ranging from abandonment of cover, avoidance response, short-term reduction in feeding rates and success, and moderate physiological stress with increased coughing and respiration rates (USFWS 2010c). As described above, an SEVof 6 indicates adverse effects to adult and subadult bull trout (Table 7), through causing moderate levels of physiological stress.
- Schroeder 2014 anticipated that the turbidity plumes created would not exceed 5 NTUs above background beyond 3,000 ft downstream or 450 ft laterally (under the worst case scenario) within the river channel below any work zone at any one time. These dimensions would equate to roughly 30 acres of affected surface area that would extend to the riverbed; this area would move as the dredge moves.
- Based on the modeling provided by Schroeder, the results of previous monitoring, and the analysis in bullets above, it is likely that bull trout remaining in turbidity plumes may be exposed to turbidity levels indicating behavioral changes from exposure to at least 20 mg/L (8 NTU) for periods of at least 7 hours, and nearer the dredge higher levels of turbidity that indicate physiological stress. These exposures may occur within an area of 450 ft measured laterally (based on Schreder 2014), and up to 300 ft downstream typically, or 900 ft downstream in a worst case scenario (based on previous monitoring and rapid response capability). Due to the fact that tubidity decreases with distance from source, we expect that at closer locations to the dredging site, it is likely that bull trout remaining in the plume would be exposed to higher levels of suspended sediment, resulting in sublethal adverse effects, such as those identified in Table 9.

To monitor for State water quality standards for the Project, the Corps will measure turbidity at 300 and 900 ft away from the dredging and disposal activities (BA, p. 16). While the State water quality standards do not by themselves provide a turbidity or suspended sediment level that indicates adverse effect to bull trout, the monitoring stations can be used as a proxy for monitoring levels that may indicate adverse effects closer to the dredge or disposal activity. Therefore, for the purposes of this Opinion, Washington State water quality standards (i.e., NTU criteria) are used as a reasonable proxy for monitoring and quantifying adverse effects to bull trout, and the levels of adverse effect are described in more detail below.

The typical winter work window of December 15 to March 1 in the Snake River was developed mainly for anadromous fish, and don’t minimize impacts to the bull trout that use the Snake River for foraging, migration, and overwintering. Bull trout may occur in the Action Area year round. While densities of bull trout are likely low, their distribution in the winter is not well known. Typical salmon and steelhead monitoring and capture facilities, including ladders, do not run or are not monitored throughout the winter. Bull trout migrate large distances, and may occur in the dredging or disposal areas in the winter.

Based on the Corps's 2005/2006 and 2014/2015 turbidity monitoring data, the USFWS does not expect that any lethal effects to bull trout due to suspended sediments and turbidity from the proposed Project activities that will occur. However, various behavioral or sublethal effects are expected to occur to any bull trout that may be present and exposed to elevated turbidity and suspended sediment levels beyond behavioral or sublethal thresholds. Due to the long extended dredging operations (77 days) during the time when bull trout may be in the area, the USFWS expects exposure of subadult and adult bull trout is reasonably certain to occur, despite the low densities of bull trout within the Action Area. Project impacts associated with increased turbidity and suspended sediments resulting from the proposed in-water work will be temporary and would be expected to last for various lengths of time. The USFWS expects that the proposed dredging and disposal operations will result in adverse effects to bull trout up to 900 ft downstream of the dredging and disposal activities.

Based on previous dredging operations, the USFWS assumes the Corps will establish 800 foot by 600 foot work zones for dredging above set monitoring locations (Corps 2014, cited in USFWS 2014b; Tice, B., in litt. 2022b). The Corps will continuously record turbidity levels at two set locations downstream of the established work zone, 300 ft for early warning, and 900 ft for compliance (BA, p. 16). These turbidity monitoring locations are the same as work progresses through the established dredging and disposal work zones. As such, the early warning and compliance monitoring stations could be as much as 1,100 ft and 1,700 ft from the generation points of the plume (i.e., operation of the clamshell and water discharge from the barge), respectively, and as much as 300 ft laterally off-set in the channel. It is anticipated that the turbidity plumes created by the proposed project could result in adverse effects to bull trout within 900 ft downstream and 450 ft laterally below any work site (i.e., actual location of the dredge and barge). These dimensions equate to roughly 9.3 surface acres of the river channel down to the riverbed at any one time. This plume may occur anywhere within a roughly 41 acre (i.e., 1,700 ft by 1,050 ft) area from the upstream end of, and encompassing, each established work zone. The location of the 300 foot and 900 foot monitoring locations will be known, and the Corps committed in the BA that water quality monitoring will be conducted at the dredging and disposal sites in near real-time so that operational changes can occur rapidly if water quality standards are exceeded (BA, p. 16). Data for future sediment modelling will be more precise if the Corps also tracks the location of the dredging and disposal activity in relation to the monitoring sites.

Based on the above information and the results of monitoring that has occurred during past dredging and disposal operations, the USFWS does not anticipate any lethal or paralethal effects to bull trout due to turbidity from the proposed Project activities. However, various behavioral or sublethal effects are expected to affect small numbers of bull trout that remain within or enter the turbidity plumes created downstream of each active work site. The USFWS expects that adverse effects to bull trout through behavior modification will occur no more than 900 ft downstream and 450 ft laterally of dredging activities, and adverse effects through sublethal effects will occur within 300 ft downstream and 450 ft laterally of dredging activities. Adverse effects will occur at the following turbidity levels (Table 9).

Behavioral modification, such as alarm reaction, avoidance response, or abandonment of cover that created a likelihood of injury, will occur within 900 ft:

- When NTUs exceed 62 NTUs at any time.
- When NTUs exceed 41 NTUs for 1 continuous hour.
- When NTUs exceed 17 NTUs for up to 3 hours, cumulatively.
- When NTUs exceed 8 NTUs for up to 7 hours, cumulatively.

Sublethal effects, such as reduced foraging efficiency, physiological distress, impaired homing, will occur within 300 ft:

- When NTUs exceed 461 at any time.
- When NTUs exceed 372 for up to 1 continuous hour.
- When NTUs exceed 145 for up to 3 hours, cumulatively.
- When NTUs exceed 70 for up to 7 hours, cumulatively.

Effects to Designated Critical Habitat for Bull Trout

The final revised rule designating bull trout critical habitat (75 FR 63898 [October 18, 2010]) identifies nine Primary Constituent Elements (PCEs) essential for the conservation of the species. The 2010 designation of critical habitat for bull trout uses the term PCE. The new critical habitat regulations (81 FR 7214) replace this term with physical or biological features (PBFs). This shift in terminology does not change the approach used in conducting our analyses, whether the original designation identified PCEs, PBFs, or essential features. In this opinion, the term PCE is synonymous with PBF or essential features of critical habitat.

The proposed project is located in the lower Mainstem Snake River Critical Habitat Unit (CHU) and lowest two miles of the lower Clearwater River CHU. Bull trout use the Action Area for foraging, migrating, and overwintering. PCE 5 (water temperature) and PCE 6 (spawning habitat) are absent in the Action Area. Across the CHU's, several PCEs are not functioning properly (i.e., adverse baseline) as a result of dam operations and reduced riparian habitat and function. PCE 2 (migration habitat) and PCE 3 (abundant forage base) are functioning at risk, and none of the PCEs in the CHU are functioning appropriately. The BA (pp. 55 – 63) describes the environmental baseline of the pathways and indicators that contribute to the function of the PCEs in the Action Area. Pathways and indicators are functioning at risk (chemical contamination and physical barriers) or not functioning properly within the Action Area, consistent with conditions in the greater CHU.

PCE 1: Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

Dredging and disposal operations, including redistribution of sediments resulting from settling of tubidity plumes, may influence springs or connectivity to hyporheic zones. Given the subsrate size in Ice Harbor lock approach, we expect the proposed action will have no effect on PCE 1. Effects to PCE 1 may occur in Lower Granite Reservoir, but the location of springs and hyporheic zone is currently unknown. However, all dredging will occur at previously dredged sites and we expect PCE 1 to continue functioning in these areas at or near baseline levels. In the event springs or hyporheic connectivity occur at the disposal site, depositing dredge spoils may influence springs or hyporheic connectivity, which may reduce the availability of thermal refugia in those locations, but the size of the disposal area is relatively small compared to the size of the rivers. We expect areas throughout the mainstem to continue to provide cold water or natural hyporheic connectivity, as described in section 9, *Environmental Baseline*, of this opinion, and the proposed project will not affect wetlands, off channel, or floodplain connectivity. Although there may be some local adverse effect to PCE 1 at Bishop Bar, we do not expect the local impacts at the disposal site will measurably reduce the current function of PCE 1 at the CHU level; therefore, we expect the effects to PCE 1 will be insignificant.

PCE 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.

The proposed activities may result in increases in the level of turbidity and suspended sediments within the immediate area of the Ice Harbor Lock downstream approach. However, these potential impacts would not be expected to create any significant or long-lasting physical, biological, or other barrier that would impede bull trout migration patterns due to the small size of the project footprint compared to the width of the river and ability of bull trout to avoid project-related disturbances. Likewise, we do not expect any impediment to migration as equipment is transported between dredging and disposal sites.

Excessive turbidity as a result of the proposed dredging and disposal activities in the Lower Granite Reservoir (including lower Clearwater River) may impact migration habitat for bull trout within the immediate area of the dredging operation, from the river surface to the riverbed on a moving-window basis (i.e., as the work progresses through the dredging and disposal work zones)), amounting up to 9.3 surface acres of the river channel for each dredge plant used, during actual dredging and disposal operations and for approximately one additional hour following completion of work at each site. The total area ultimately subject to these impacts includes the combined area of all the work zones established to address the entire dredging and disposal footprints and an area 900 ft long by 450 ft wide downstream of these zones at any one time (see section 10.2.1, *Effects to Bull Trout from Turbidity and Suspended Sediments*, of this opinion). Depending on work conditions during the dredging operations, these impacts would be expected to be nearly continuous for the duration of dredging, which is expected to impair migratory passage at those locations, but most dredging will be completed using a single dredge plant, which will limit the events resulting in larger-scale disturbance. Where the river is more narrow, such as in the lower Clearwater where the channel reaches approximately 655 ft across, the magniture of the impediment would be greater; however, the project implementation will occur outside of peak migratory periods and we expect passage around the turbidity plume will continue to be available for migrating individuals. The impacts at Bishop Bar are expected to be periodic for up to 80 minutes every eight hours during disposal operations and any final contouring or stabilizing activities, confined to one side of the Snake River channel. The size and duration of the activity may result in water quality impediments to migration in local areas, locally degrading and resulting in adverse effects to PCE 2, but would not impact the entire width of the river. The USFWS concludes that these impacts would not significantly impair the continuing function of this PCE for bull trout in the Action Area because areas within the river channel adjacent to the affected sites would remain undisturbed and because we do not expect migratory impairment across the remaining portions of the Action Area (outside of Lower Granite Reservoir).

PCE 3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

The proposed activities may result in localilzed increases in the level of turbidity and suspended sediments within the immediate area of the Ice Harbor Lock downstream approach. However, these potential impacts would not be expected to result in any measurable effects to bull trout food resources due to the limited extent of impacts. The Corps has committed to performing pre-dredging redd surveys at the Ice Harbor navigation lock approach to assure that the proposed action will not damage fall Chinook redds that may be present in the dredging area (BA, p. 18). Given the small dredging footprint at this site and minimal releases of fines, impacts to PCE 3 are expected to be insignificant.

The proposed dredging and disposal activities in Lower Granite Reservoir and lower Clearwater River may affect bull trout prey as a result of removing sediment or in-water deposit of sediment. Impacts would be due direct impacts to forage fishes or due to physical disturbance of existing riverbed substrates and subsequent impacts to benthic organisms, which bull trout prey species feed on. The total work area identified in the BA is up to 100 acres at the confluence of the Snake and Clearwater Rivers and about 23 acres at Bishop Bar, although the actual area that will be dredged is likely to be much lower (Tice, B., in litt. 2022b). The impacts to benthic invertebrates would be expected to last for up to several months following completion of the operations. Benthic invertebrates contribute little to the diet of salmon and steelhead smolts and adults (NMFS 2014, pp. 58 – 59), but native salmonids may experience lower feeding rates upon moving away from dredging or disposal operation.

Redistribution of contaminants bound to sediments that may become available to benthic organism or forage fish that make up the foundation of the food web may alter the bioavilability of sediment-bound contaminants, which may reduce or alter the benthic invertebrate comminuty, alter salmonid foraging patterns that increase bioaccumulation rates, which may reduce survival and reproductive rates, especially as contaminants are passed to eggs and larvae that are more sensitive to mortality. However, none of the dredge sediment tested by the Corps in 2019 exceeded the Corps' established criteria and all sediments were deemed suitable for in-water disposal (BA, p. 73). The Corps has committed to placing fine sediments from the Port of Clarkston under a sand cap to cover any potential contaminants from the substrate/water interface (Tice, B., *in litt.* 2022d), reducing but not entirely eliminating bioavilability to benthic organisms and the forage fish that prey on them. The Service has determined that redistribution of contaminants caused by relocating sediments from shallow water habitat to mid-depth habitat, primarily within Lower Granite Reservoir, is not likely to cause significant reduction in the forage base of bull trout.

Although the proposed action is likely to impair the availability of aquatic invertebrates and may reduce feeding rates of forage fish upon which bull trout prey, the USFWS concludes that these impacts would not significantly impair the continuing function of this PCE of designated critical habitat for bull trout in the Action Area because ample areas within the river channel adjacent to the affected sites would remain undisturbed. The proposed action would have insignificant effects on PCE 3 at the CHU level.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

The proposed activities at the Ice Harbor Lock downstream approach would be expected to have no effect on PCE 4. The proposed dredging and disposal activities in the Lower Granite Reservoir and lower Clearwater River would be expected to have a negligible effect on the complexity of the aquatic environment in the Action Area, removing primarily mid-depth habitat (greater than 6 ft to 16 ft) and relocating it to mid-depth habitat (20 to 60 ft), slightly increasing the availability of mid-depth habitat. The dredging would add additional areas of slightly deeper channel at the dredging locations; however, deeper pool-type habitats are not limited in the Snake and Clearwater Rivers. Ultimately, the proposed action is expected to have insignificant effects on this PCE in the Action Area and across the larger CHU.

PCE 5: Water temperatures ranging from 2 °C to 15 °C (36 °F to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shading (e.g., provided by riparian habitat), streamflow, and local groundwater influence.

As previously described, this PCE is considered to be absent from the lower Snake River and considered absent from the Action Area. However, water temperature in the winter time is within the range of PCE 5, bull trout continue to move through the Action Area, and the proposed action may still result in modification to habitat factors that impact temperature. The proposed activities at the Ice Harbor Lock downstream approach would be expected to have no effect on PCE 5 due to the very small amount of fines available for release to the water column and short duration of dredging. The proposed disposal activities in the Lower Granite Reservoir may result in a very slight decrease in water temperature due to reduced effects from solar radiation and less mixing of the water column in the immediate vicinity of the newly created mid-depth habitat at the confluence of the Snake and Clearwater Rivers, and is unlikely to affect Bishop Bar due to the existing and resultant water depth at the location that will continue to range between 20 and 35 ft. Solar radiation in areas of project-related turbidity has the potential to increase water temperature, especially where turbidity persists for a length of time; however, these effects would be temporary until turbidity settled out and ultimately are expected to be immeasurable given the small size of the turbidity plume (the size of which will be controlled through response to water quality monitoring) relative to the surrounding river. None of these potential effects would be expected to result in any measurable effects to bull trout that may occur in the Action Area, nor would we expect significant modification of PCE 5 from baseline conditions; therefore, effects to PCE 5 are considered insignificant.

PCE 6: In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo over-winter survival, fry emergence, and young-of-the-year and juvenile survival.

Spawning and rearing does not occur within the Action Area. Therefore, the proposed action will have no effect on PCE 6.

PCE 7: A natural hydrograph, including peak, high, low and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

The hydrograph in the Action Area is already highly modified due to flood control and hydroelectric dams. We do not expect any effect to PCE 7 from Project-related activities near Ice Harbor Dam. Stream flows may be slightly altered over the long-term at the confluence of the Snake and Clearwater rivers due to dredging and dispoal, but dredging will occur at previously dredged sites and any influence on flows is expected to be minor. The proposed dredging and disposal activities are not expected to significantly affect the hydrograph of the Snake or Clearwater Rivers in the Action Area; thus effects to PCE 7 are expected to be insignificant.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

The USFWS expects no effect on water quantity in the Action Area, but effects to water quality may occur as a result of resuspended contaminants or excessive turbidity We have determined that the proposed activities in the Ice Harbor Lock downstream approach would not be expected to result in any measurable effects to water quality parameters.

Effects to PCE 8 may occur in the Lower Granite Reservoir as a result of resuspended contaminants during dredging or through impacts to water quality associated with release of turbidity and suspended sediments. Sediments proposed for dredging in Lower Granite Reservoir and lower Clearwater River were screened for the presence of contaminants prior to dredging, following procedures by Corps et al (2013) and Michelsen (2011). The Corps tested for 37 chemicals of concern (Corps et al. 2013) known to be found in rivers of the Pacific Northwest that may be toxic to aquatic organisms at certain concentrations. However, none of the contaminants tested in 2019 for the proposed project exceeded the Corps' established criteria and sediments were deemed suitable for in-water disposal (BA, p. 73). Contaminants not tested for suitability may be translocated from shallow water habitat in dredging areas to mid-elevation habitat at Bishop Bar. Most contaminants of concern are expected to be bound to fine sediments, which will be placed at Bishop Bar and covered with a cap of coarser sand material, which will reduce but not completely eliminate potential release to the water body. Due to the low velocity and structured placement, as well as monitoring to confirm stability of the disposal site, we expect these materials to largely remain within the Lower Granite Reservoir. As most sediments

(85 percent) that enter Lower Granite Reservoir tend to settle out and remain in the reservoir (BA, p. 7), we do not expect the relocation of materials from upstream areas, where approximately 50 percent of materials that enter the reservoir settle out, to Bishop Bar to induce a significant change in water quality parameters in the Action Area.

The proposed dredging and disposal activities in the Lower Granite Reservoir and lower Clearwater River would be expected to impact the water quality for bull trout within the Action Area due to excessive turbidity. The extent, intensity, and timing of these water quality impacts from turbidity and suspended sediment would be the same as those described above in the bull trout effects section. The effects to the water quality near the dredging and disposal areas are considered adverse, resulting in adverse effect to PCE 8; however, these effects are expected to be localized to the moving-window of the dredging areas and to the disposal area, including the area of impact described previously. Effects to water quality from excessive turbidity are expected to be temporary at any given location, although excessive turbidity will occur at specific dredging locations throughout the dredging season (December 15 to March 1) and near continuous at the disposal site. Large portions of the river will remain undisturbed as the extent of turbidity is controlled through measures intended to meet water quality standards. For these reasons, the USFWS concludes that these impacts would not significantly impair the continuing function of PCE 8 because ample areas within the river channel adjacent to the affected sites would remain undisturbed.

PCE 9: Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass), interbreeding (e.g., brook trout), or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

Effects to PCE 9 are most likely to occur through the availability of overhead cover that may provide advantage to predatory species. Although predatory fish may use overhead cover from barges to prey on listed fish, moored barges are unlikely to offer much advantage to predators because the sporadic mooring of vessels would not provide a consistent or predictable environment that would enable predatory fish to congregate at the ports. The USFWS expects the proposed dredging and disposal activities in would not change the occurrence of any non-native predatory, interbreeding, or competing fish species in the Action Area.

11 CUMULATIVE EFFECTS: Bull Trout and Designated Bull Trout Critical Habitat

Cumulative effects include the effects of future state or private activities, not involving federal activities, that are reasonably certain to occur in the Action Area, and are considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Many, if not most, of the cumulative effects described in the USFWS' 2014 PSMP BO continue to be relevant. We expect many impacts from non-Federal activities in the Action Area that have degraded or hindered the conservation of listed species, specifically bull trout and its designated critical habitat, will continue in the foreseeable future at similar intensities as in the recent past. Thus, the cumulative effects described in the PSMP BO (pp. 79 – 81) are incorporated by reference and summarized here, and are updated where appropriate.

Because the Action Area primarily encompasses aquatic environments, water quality and availability are the primary avenues for adverse effects to listed resources. In a large river such as the lower Snake and Clearwater Rivers, habitat conditions in the Action Area are influenced by countless activities that have the potential to affect stream flows or water quality, some of which occur upstream, outside the Action Area. Information on specific planned or foreseeable non-Federal activities is uncertain, but we expect effects of future urban growth, forestry activities, sediment caused by agricultural practices, and flow reductions from water withdrawals will continue to be among the most significant activities affecting bull trout and critical habitat in the Action Area. Within tributaries that influence the Action Area, habitat degradation, migration barriers, resource competition, degraded water quality, water flow fluctuations, and non-native invasive species are likley to continue to contribute to cumulative effects. Agricultural practices are likely to continue to influence water quality and quantity, and run-off is expected to continue to contribute contaminants throughout the broader area. Likewise, urban and rural land uses for residential, commercial, industrial, and recreational activities, such as boating and golf courses, often require water withdrawals and can further contribute pollutants and sediments to surface waters, thereby degrading aquatic habitats.

Washington, Oregon and Idaho have all developed total maximum daily load restrictions for various water quality components, turbidity, temperature, pesticides, heavy metals and others in the Snake River, Clearwater River, and some of their tributaries (WDOE 2021; IDEQ 2022). As these plans are carried out water quality may improve. In Washington State, the EPA has delegated National Pollutant Discharge Elimination System (NPDES) permitting authority to the State, which issues NPDES permits. Section 7 consultation with EPA on the effects of these State-issued permits is not always conducted. These State-permitted discharges would be expected to contribute to cumulative effects within the Action Area.

The Snake River basin is one of many areas in the State of Washington that is experiencing ongoing wind power developments and expansion of transportation infrastructure. Population changes and economic diversification are likely to result in greater overall and localized demands for electricity, water, and buildable land in the Action Area. As the human population in and around the Action Area continues to grow, demand for dispersed and developed recreation is likely to occur. They may affect water quality directly and indirectly and increase the need for transportation, communication, and other infrastructure. These economic and population demands will probably affect habitat features such as water quality and quantity. Even where an action by itself may have only a small incremental effect, taken together, numerous minor actions may have a substantive effect that would further degrade habitat in the Action Area and undermine efforts to improve the habitat conditions.

There are a number of other non-federal actions that are expected to address potential impacts to bull trout from urban development within the broader region encompassing the Action Area. State and local regulations, as well as education programs and conservation plans, are expected to mitigate some of the potential effects of development and may reduce the impacts to listed species and their habitat. Some of these approaches include initiatives under Critical Areas Ordinances and measures associated with the State's Shoreline Management Act (SMA). Salmon recovery efforts in the Action Area have assisted with numerous projects to improve habitat for listed salmon and steelhead, and often have beneficial effects to bull trout. Ongoing studies and habitat enhancement projects conducted by the Snake River Salmon Recovery Board and Washington State Department of Fish and Wildlife to implement watershed plans and recovery plans are expected to continue, as are efforts by local restoration groups. Various other entities have developed plans and conservation initiatives that may benefit listed species within the broader region encompassing the Action Area; however, comprehensive results from most of these ongoing or planned actions must be documented before they can be considered reasonably foreseeable for purposes of cumulative effects analyses.

Considering the available information, cumulative effects within the Action Area that are reasonably certain to impact bull trout and bull trout critical habitat are the same or similar to those that have been occurring, and are likely to increase in the future. Unless planning includes measures to avoid, minimize, and effectively mitigate the potential effects to listed species, the effect of continued growth and economic diversification will likely be negative. On-going activities described in the baseline are likely to continue. We are not aware of any specific, significant new or changes to existing state, tribal, local, or private activities within the Action Area.

12 INTEGRATION AND SYNTHESIS OF EFFECTS: Bull Trout and Designated Bull Trout Critical Habitat

The Integration and Synthesis section is the final step in assessing the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action and cumulative effects to the environmental baseline and, in light of the status of the species and critical habitat, formulate the USFWS' opinion as to whether the proposed action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

The proposed action is a second-tier action under the Corps' Programmatic Sediment Management Plan. The Corps will perform maintenance dredging to remove shallow to mid-depth (up to 16 ft) sediment accumulations at five locations along the lower Snake River and lower Clearwater River, including the removal of coarse gravel/cobble at the Ice Harbor downstream lock approach and the removal of sand and fines from the federal navigation channel at confluence of the Snake and Clearwater Rivers, the Ports of Clarkston and Lewiston berthing areas, and the access channel at the Port of Clarkston. Total sediment removal was quantified at 257, 910 cy but may be somewhat greater following the 2022 spring flows, not to exceed 500,000 cy. Using a single barge group that consists of multiple vessels, bucket dredging will remove material at the Ice Harbor approach first then deposit the material at Bishop Bar in the Lower Granite Reservoir before moving upstream to complete dredging in the Lower Granite Reservoir and lower Clearwater River locations. Dredging may occur throughout the December 15 to March 1 winter work window and may be continuous throughout the day and night, dredging up to 7,200 cy of material each 24-hour period and depositing material at Bishop Bar in existing mid-depth habitat. All dredging activities will be completed in a single December 15 to March 1 season. A deviation from previous maintenance actions, disposal will not increase the availability of shallow water habitat that would improve rearing habitat for subyearling fall Chinook, despite the removal of shallow water habitat from the Port of Clarkston. Shallow water habitat is limited across Lower Granite Reservoir. Water quality monitoring will occur concurrent with dredging and disposal at each site, and hydrographic surveys will occur concurrent and following disposal at Bishop Bar to assure long-term stability at the disposal site.

The Action Area extends from approximately 2.5 miles downstream of Ice Harbor approach on the lower Snake River upstream to approximately Clearwater RM 1.2. Spawning and early rearing does not occur in the Action Area, nor does the Action Area overlap any Core Area. The Action Area occurs within designated FMO critical habitat, overlapping the Snake River and Clearwater River shared FMO habitat that supports the viability of bull trout populations by contributing to successful overwintering survival and dispersal among Core Areas. The most important habitat requirements for bull trout in the Action Area, which includes subadult and adult age classes, include adequate forage base and unimpeded migratory passage. The status of bull trout in the Action Area is influenced by factors occurring both within the Action Area as well as the condition of the Core Areas from which bull trout in the Action Area originate. The status of bull trout in the Action Area is influenced by multiple federal dams and numerous other anthropogenic structures and activities that have degraded or negatively modified habitat in such a way that limits connectivity and reduces access to historic habitats. Most critical habitat PCEs are not functioning properly, and the PCEs for migration and foraging are functioning at risk. While dam-related disruption in sediment transport cycles contributes to the degraded condition in the Action Area, dredging has not been identified as a contributing factor to the status of bull trout in the Action Area, but sedimentation contributes to degraded water quality conditions.

The proposed action is expected to result in episodic events of elevated turbidity and suspended sediment in exceedance of thresholds that are likely to result in adverse effects to bull trout at each dredging and disposal event in the Lower Granite Reservoir. We do not expect adverse effects to bull trout that occur near project-related activities near the Ice Harbor lock approach. Bull trout exposed to elevated turbidity plumes, either by remaining within or entering plumes, are likely to experience sublethal effects or significantly modify typical behaviors that increase the likelihood of injury, such as through abandonment of suitable habitat. Project impacts associated with turbidity resulting from the proposed in-water work would be temporary and different aspects would be expected to last for various lengths of time at each specific location, but would continue up to 24 hours per day between December 15 and March 1 (77 day work window, or 1848 hours) for a single winter season. At any one time the turbidity plume of each dredge plant may extend 900 ft long by 450 ft wide, covering an area of 9.3 acres from river bed to surface, but most operations are expected to be completed using a single dredge plant. Due to the low density of bull trout in the Action Area, our expectation that most bull trout tend to avoid excessive turbidity, and the availability of suitable habitat in the adjacent river channel, we expect a only small number of bull trout that occur near elevated turbidity plumes may be exposed to project-related turbidity plumes to an extent or for a duration enough to experience adverse effects.

The number of bull trout that may be exposed to project-related turbidity is difficult to quantify, but the fact that most of the Project operations will be completed using a single dredge plant and real-time turbidity monitoring allows quick response to exceedances in state water quality standards is expected to limit the frequency, duration, and spatial extent of elevated turbidity events that rise to the level of causing injury. Bull trout in the lower Snake and Clearwater

Rivers are comprised of a mix of individuals from several local populations and Core Areas, including bull trout from the Tucannon River, Asotin Creek, Imnaha River, and Core Areas of the Grande Ronde River and Clearwater Rivers. The Tucannon and Asotin Core Areas are considered depressed, while the remaining Core Areas are considered stable. Impacts to the bull trout (i.e., the number of individuals experiencing adverse effects) are likely to be spread among several local populations and across several Core Areas, limiting the severity of impact to any one local population. As spawning and rearing does not occur in the Action Area, we do not expect the proposed action to directly reduce reproduction, but there may be some indirect impact to reproduction in the form of reduced fecundity in one or more bull trout that experience adverse effects, but we do not expect the Project to result in lethal harm and Project-related impacts will be limited to a single winter season. Due to the fact that long distance migrants make up a small portion of any one local population and multiple populations likely contribute to the total number of bull trout that may be adversely affected, we do not expect the proposed action to measurably reduce the number of bull trout in any one local population. Therefore, we do not expect measurable reduction in the number of bull trout in any Core Area or within the Recovery Unit.

The proposed action is not expected to measurably reduce foraging habitat or significantly impede migration across the Action Area. Although we expect some localized adverse impacts to the foraging and migrating PCEs, we do not expect the project to induce long-term reduction in the function of any PCE or result in adverse effects to any PCE at the CHU scale. Avoidance of turbidity plumes will likely result in localized changes in habitat occupancy, but we do not expect the proposed action to significantly impact the overall distribution of bull trout across the Action Area because of the limited spatial and temporal effects of the action, that leave large portions of the river channel unaffected by the proposed action, and bull trout can reoccupy vacated areas upon completion of dredging at each individual location.

Considering the above information, the USFWS concludes that the proposed action will not reduce the suitability of the Action Area to provide adequate foraging, migration, and over-wintering habitats for bull trout that may be present in the lower Snake and lower Clearwater Rivers. In addition, the proposed action will not prevent or result in long-term impairment of connectivity to local populations of bull trout between multiple Core Areas in neighboring major tributaries throughout the broader region, including those within the Tucannon River, Asotin Creek, Imnaha River, Grande Ronde River, and Clearwater River watersheds. The available information indicates that cumulative effects may be positive or negative to bull trout over the long-term within the Action Area, however, given the geographic scope of the Action Area, the assessment of cumulative effects is currently very general. Based on the above, the USFWS concludes that the proposed Project would not be expected to significantly impact the conservation role of the Action Area or to diminish the distribution or survival of local populations of bull trout within the broader region. Therefore, the USFWS concludes that the Project would not significantly impact bull trout within the Mid-Columbia Recovery Unit or within the coterminous U.S. range of the species. The ability of the Action Area to support sufficient foraging, migration, and over-wintering habitats for bull trout and to provide connectivity between neighboring Core Areas would not be diminished in the Mainstem Snake River and Clearwater River CHUs as a result of the proposed action.

The USFWS has reviewed the current status of the bull trout and critical habitat for the bull trout, the environmental baseline for the Action Area, the effects of the proposed Project, and cumulative effects within the Action Area. While an indeterminate number of bull trout may be adversely affected by the proposed activities (e.g., sublethal effects due to turbidity and temporary degradation of habitat conditions), it is the USFWS' biological opinion that the proposed project is not likely to jeopardize the continued existence of bull trout within the Mid-Columbia Recovery Unit and is not likely to destroy or adversely modify designated critical habitat for the bull trout within the mainstem Snake River or Clearwater River CHUs. Incidental take may occur to individual bull trout exposed to suspended sediment and turbidity levels that indicate adverse effects.

13 CONCLUSION: Bull Trout and Designated Bull Trout Critical Habitat

The proposed Snake River Channel Maintenance Project represents a second-tier consultation under the Corps' Programmatic Sediment Management Plan. In our first-tier biological opinion on the PSMP, we determined that the PSMP would not result in jeopardy to the bull trout or adversely modify designated bull trout critical habitat. The PSMP envisioned the need for future second-tier consultation to confirm that predicted quantities of dredged or deposited sediment in the PSMP are not exceeded, that potential effects to the bull trout or bull trout critical habitat are consistent with those considered under the PSMP, and to evaluate the extent of take. Through our evaluation, we determined that the Snake River Channel Maintenance Project conforms to the PSMP in the quantity of dredged sediment and consistency in potential effects to bull trout and bull trout critical habitat considered in the first-tierbiological opinion.

After reviewing the current status of bull trout, the environmental baseline for the Action Area, the effects of the proposed Snake River Channel Maintenance and the cumulative effects, it is the USFWS' biological opinion that the Snake River Channel Maintenance, as proposed, is not likely to jeopardize the continued existence of the bull trout or is not likely to destroy or adversely modify designated critical habitat.

14 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. *Harm* is defined by the USFWS as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). *Harass* is defined by the USFWS as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

15 AMOUNT OR EXTENT OF TAKE

The USFWS anticipates incidental take of bull trout will be difficult to detect for the following reason(s):

- The Action Area is located within the lower Snake River and Clearwater River shared FMO habitat. The bull trout is wide-ranging within suitable habitat throughout shared FMO habitat but are difficult to detect due to its preference for residing in fast-moving water near the bottom of the water column and tendency to remain under cover during the day. Bull trout from multiple Core Areas interact with the shared FMO area, but the exact number of bull trout that use the shared area is unknown and, for a number of populations, use is assumed but undocumented. The fate of many tagged bull trout that have entered the shared FMO habitat is unknown but, based on the available information, bull trout density in these shared FMO habitats is assumed to be low.

- Changes in bull trout numbers or in the reproductive potential of bull trout in the Action Area caused by take incidental from project-related activities is likely to be masked by natural, seasonal fluctuations or by other causes, such as bull trout behavioral changes in response to changes in water quality or flow velocities. Changes in bull trout numbers in the Action Area caused by take incidental from project-related activities are also likely to be masked by effects associated with dam operations or other anthropogenic stressors, or by natural predation. Finding bull trout that have been injured or died is unlikely because they are likely to be swept downstream or preyed upon.

- The relationship between habitat conditions and the distribution and abundance of individual bull trout is imprecise such that a specific number of affected individuals cannot be practically obtained.

Pursuant to 50 CFR 402.14(i)(1)(i), a surrogate can be used to express the anticipated level of take in an Incidental Take Statement, provided three criteria are met: (1) measuring take impacts to a listed species is not practical; (2) a link is established between the effects of the action on the surrogate and take of the listed species; and (3) a clear standard is set for determining when the level of anticipated take based on the surrogate has been exceeded.

The USFWS' regulations state that significant habitat modification or degradation caused by an action that results in death or injury to a listed species by significantly impairing its essential behavior patterns constitutes take in the form of harm. Those regulations further state that an intentional or negligent act or omission that creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt its normal behavioral patterns constitutes take in the form of harass. Such annoyance can be caused by actions that modify or degrade habitat conditions (e.g., excessive noise or smoke). In cases where this causal link between effects of a federal action to habitat and take of listed species is established, and the biological opinion or incidental take statement explains why it is not practical to express and monitor the level of take in terms of individuals of the listed species, the USFWS' regulations authorize the use of habitat as a surrogate for expressing and monitoring the anticipated level of take, provided a clear standard is established for determining when the level of anticipated take has been exceeded.

The following narrative presents the USFWS' analysis and findings with respect to the three regulatory criteria for use of a surrogate in this Incidental Take Statement to express the anticipated level of take likely to be caused by the proposed action.

The discussion above explains why it is not practical to express the amount or extent of take in terms of individual bull trout. It is the USFWS' customary practice to rely on habitat impacts to inform the determination of bull trout take impacts. For this reason, quantifying and monitoring impacts to bull trout habitat caused by the proposed project is a scientifically credible and practical approach for expressing and monitoring the anticipated level of bull trout take in situations where monitoring of take impacts in terms of individual bull trout is not feasible or practicable. Based on the best available information and research, the USFWS has established a causal link between elevated turdibity levels and injury or harm to bull trout, described in section 10.2.1.1, *General Impacts to Bull Trout From Exposure to Elevated Turbidity and Suspended Sediments,* of this opinion. We anticipate that some level of incidental take of bull trout wherever elevated turbidity levels exceed threshold known to result in sublethal and/or behavioral effects that create a likelihood of injury by significantly disrupting normal behaviors.

Incidental take of adult and subadult bull trout is anticipated in the form of harm through a significant disruption of normal behaviors that cause abandonment of suitable habitat due to exposure to high levels of turbidity associated with dredging and disposal activities from the location of the activity to a point 900 ft downstream. The turbidity plume moves throughout the dredging and disposal areas with the sediment producing activity. Incidental take will result when levels of turbidity reach or exceed any of the following parameters within 900 ft of dredging:

1) 62 NTUs above background at any time;

2) 41 NTUs above background for 1 continuous hr;

3) 17 NTUs above background for up to 3 hrs, cumulatively; or

4) 8 NTUs above background for up to 7 hrs, cumulatively.

The USFWS has concluded that incidental take will be exceeded should Project-related turbidity rise above these levels within 900 ft of dredging or should these turbidity levels extend beyond 900 ft from Project operations. Incidental take of subadult and adult bull trout is also expected in the form of harm through physiological stress or other sublethal impacts resulting in injury from exposure to high levels of turbidity associated with dredging and disposal activities from the location of the activity to a point 300 ft downstream. Incidental take will result when levels of turbidity reach or exceed the following within 300 ft of dredging:

1) 461 NTUs above background at any time;

2) 372 NTUs above background for 1 continuous hr;

3) 145 NTUs above background for up to 3 hrs, cumulatively; or

4) 70 NTUs above background for up to 7 hrs, cumulatively.

The USFWS has concluded that incidental take will be exceeded should these turbidity levels extend beyond 300 ft from dredging. Elevated turbidity levels resulting in incidental take are expected to occur during the proposed 77-day work window (December 15, 2022 through March 1, 2023).

16 EFFECT OF THE TAKE

In the accompanying Opinion, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

17 REASONABLE AND PRUDENT MEASURES

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Corps 1) fails to assume and implement the terms and conditions or 2) fails to require the contractor to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the USFWS as specified in this Incidental Take Statement [50 CFR 402.14(i)(3)].

The USFWS finds the following reasonable and prudent measure(s) are necessary and appropriate to minimize the impacts (i.e., the amount or extent) of incidental take of bull trout:

1. Minimize the extent and duration of elevated turbidity levels.

2. Conduct sufficient monitoring to ensure that the project is implemented as proposed and that the amount and extent of incidental take is not exceeded (CFR 402.14(i)(1)(iv) and 402.14(i)(3).

18 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the agency must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The following Terms and Conditions implement RPM 1:

    a. The Corps shall require barges to drop dredged material at Bishop Bar in a manner that minimizes turbidity. Sediment-producing activities shall pause when turbidity levels measured 900 ft downstream exceed the state water quality certification thresholds. Restart activities only when in compliance with the measures identified in the Corps' monitoring plan.

    b. The Corps shall assure that all operators and contractors adhere to the monitoring and best management practices identified in the Project BA, as well as those included in the programmatic PSMP biological assessment including, but not limited to, clear understanding of bucket control best management practices that minimize turbidity and employing an experienced equipment operator.

2. The following Terms and Conditions implement RPM 2:

    a. The Corps shall develop and implement a water quality monitoring program to determine compliance with State of Washington turbidity criteria and monitoring and reporting the amount or extent of incidental take. Details of the monitoring program shall include:

        i. Turbidity will be measured at stations located 300 and 900 ft downstream from the work zone at the dredging or disposal site, and at background stations.

        ii. The Corps shall visually monitor the turbidity plume twice daily during the first three days of operations at each of the dredging sites and the disposal site to confirm the plume does not exceed 450 lateral ft or, where the river is less than 900 ft wide, will not exceed 50 percent of the total river width.

        iii. Relative to information collected at the monitoring stations, the Corps shall continuously monitor and record the locations of the dredge and barge (i.e., work sites) within each established dredging and disposal work area, total number of dredge plants used at each of the five dredging sites, total cubic yards of material dredged at each of the five dredging sites, total cubic yards disposed of at the Bishop Bar disposal site, and the outcome of turbidity and water quality monitoring.

        iv. The Corps shall complete a final monitoring report after all activities are completed and submit it to the USFWS within six months of project completion. All reports should be sent to Julie Campbell-Hansen at julie_campbellhansen@fws.gov.

    b. The USFWS is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the USFWS' Eastern Washington Fish and Wildlife Office at (360) 753-9440.

c. The Corps shall also immediately notify the USFWS' Eastern Washington Fish and Wildlife Office at (509) 393-5883 if any emergency or unanticipated situations related to implementation of the Project may be detrimental to bull trout. Any such occurrences shall be appropriately documented by the Corps and any such reports shall be provided to the USFWS.

The USFWS believes that bull trout will be incidentally taken as a result of the proposed action, through exceedance of turbidity thresholds within 900 ft of the dredging and disposal locations. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The federal agency must immediately provide an explanation of the causes of the taking and review with the USFWS need for possible modification of the reasonable and prudent measures.

19 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The USFWS provides the following conservation recommendations with regard to the proposed Project:

1. The Corps should continue to monitor and undertake investigations to further study the presence, condition (e.g., age, size class), distribution, timing, and habitat use patterns of bull trout in the mainstems of the Snake and Clearwater Rivers and in the neighboring major tributaries. The USFWS believes that the current sampling methods likely underestimate the number of bull trout that use the lower Snake and Clearwater Rivers, particularly given the timing and the inconsistency of monitoring and counting at the dams. The Corps should coordinate with the USFWS to develop a cooperative monitoring plan to obtain more reliable information about bull trout activities, habitat use patterns, seasonal movements, distribution, and status throughout the broader region encompassing the Action Area.

2. Impaired FMO areas should be identified within Core Areas and in shared FMO habitats, and habitat improvement measures should be implemented where feasible. Recovery actions in mainstem river habitats may include flow and water temperature management, channel restoration, and improvement of structural habitat components. The Corps should investigate

the use of thermal infrared or other technologies to document water temperature profiles of the mainstem system. Such mapping may be used to detect cool water inputs that may provide important thermal refugia to bull trout and other listed salmonids.

3. Juvenile Pacific lamprey (*Entosphenus tridentatus*) are often found in silty and sandy substrates (Arntzen et al. 2012), and is one of the most widely distributed lampreys and found in the Snake River Basin as far upriver as the river reach below Hells Canyon Dam. Adults spawn in stream and river gravels where the eggs hatch into larvae and then distribute downstream to suitable rearing habitats. Pacific lamprey are at least seasonally present within the Action Area (Corps 2012a, p. 3-8) and it is possible that they could occur within the proposed dredging and disposal footprint. The Corps should conduct long-term monitoring measures and investigations for Pacific lamprey to further study the presence, condition (e.g., age, size class), distribution, and habitat use patterns of Pacific lamprey in the mainstems of the Snake and Clearwater Rivers. The Corps should survey and document colonization or recolonization rates of Pacific lamprey at dredging locations and at Bishop Bar.

4. Several species of freshwater mussels are found in the western United States (California, Oregon, Nevada, Washington, Idaho, Utah, and Montana): western pearlshell, western ridged mussel, and several floater species (*Anodonta spp.*). All of these have been documented in the Lower Snake River Basin. Adult mussels that live in the river substrate are often camouflaged in the rocks and are often buried out of sight. Because they are relatively immobile, they are more susceptible to project impacts than other, more mobile species. As with Pacific lamprey, the Corps should conduct surveys to monitor and investigate the presence and distribution of freshwater mussels in the Snake and Clearwater Rivers. The Corps should work with the USFWS or other freshwater mussels experts to incorporate best management practices into early project planning and design practices for all operations occurring within the Snake, Clearwater, and mid-Columbia River basins, including early surveys to document freshwater mussel presence and distribution, identifying potential impacts from project activities, and implementing salvage, relocating, or other protection practices, as appropriate. The Corps should survey and document colonization or recolonization rates of freshwater mussels at dredging locations and at Bishop Bar.

In order for the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

20 REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request for formal consultation on the Snake River Channel Maintenance project. As provided in 50 CFR 402.16, reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) if the amount or extent of taking specified in the incidental take statement is exceeded; (b) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) if a new species is listed or critical habitat designated that may be affected by the identified action.

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APPENDIX A
STATUS OF THE SPECIES: BULL TROUT

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Appendix A
Status of the Species: Bull Trout

Taxonomy

The bull trout (*Salvelinus confluentus*) is a native char found in the coastal and intermountain west of North America. Dolly Varden (*Salvelinus malma)* and bull trout were previously considered a single species and were thought to have coastal and interior forms. However, Cavender (1978, entire) described morphometric, meristic and osteological characteristics of the two forms, and provided evidence of specific distinctions between the two. Despite an overlap in the geographic range of bull trout and Dolly Varden in the Puget Sound area and along the British Columbia coast, there is little evidence of introgression (Haas and McPhail 1991, p. 2191). The Columbia River Basin is considered the region of origin for the bull trout. From the Columbia, dispersal to other drainage systems was accomplished by marine migration and headwater stream capture. Behnke (2002, p. 297) postulated dispersion to drainages east of the continental divide may have occurred through the North and South Saskatchewan Rivers (Hudson Bay drainage) and the Yukon River system. Marine dispersal may have occurred from Puget Sound north to the Fraser, Skeena and Taku Rivers of British Columbia.

Species Description

Bull trout have unusually large heads and mouths for salmonids. Their body colors can vary tremendously depending on their environment, but are often brownish green with lighter (often ranging from pale yellow to crimson) colored spots running along their dorsa and flanks, with spots being absent on the dorsal fin, and light colored to white under bellies. They have white leading edges on their fins, as do other species of char. Bull trout have been measured as large as 103 centimeters (41 inches) in length, with weights as high as 14.5 kilograms (32 pounds) (Fishbase 2015, p. 1). Bull trout may be migratory, moving throughout large river systems, lakes, and even the ocean in coastal populations, or they may be resident, remaining in the same stream their entire lives (Rieman and McIntyre 1993, p. 2; Brenkman and Corbett 2005, p. 1077). Migratory bull trout are typically larger than resident bull trout (USFWS 1998, p. 31648).

Legal Status

The coterminous United States population of the bull trout was listed as threatened on November 1, 1999 (USFWS 1999, entire). The threatened bull trout generally occurs 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 in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 4; Brewin and Brewin 1997, pp. 209-216; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 715-720).

Throughout its range, the 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, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (USFWS 1999, p. 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007, entire; Rieman et al. 2007, entire; Porter and Nelitz. 2009, pages 4-8). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

Life History

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route. Additionally, in some Core Areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989, p. 30; Pratt 1985, pp. 28-34). The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982, p. 95).

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989, p. 141). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, pp. 15-16; Pratt 1992, pp. 6-7; Rieman and McIntyre 1996, p. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 1). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992, p. 1; Ratliff and Howell 1992, p. 10).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002, p. 9) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007, p. 10). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995, Ch 2 pp.

23-24). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Population Dynamics

Population Structure

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, p. 2). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Goetz 1989, p. 15). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, p. 138; Goetz 1989, p. 24), or saltwater (anadromous form) to rear as subadults and to live as adults (Brenkman and Corbett 2005, entire; McPhail and Baxter 1996, p. i; WDFW et al. 1997, p. 16). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, p. 135; Leathe and Graham 1982, p. 95; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133).

Bull trout are naturally migratory, which allows them to capitalize on temporally abundant food resources and larger downstream habitats. Resident forms may develop where barriers (either natural or manmade) occur or where foraging, migrating, or overwintering habitats for migratory fish are minimized (Brenkman and Corbett 2005, pp. 1075-1076; Goetz et al. 2004, p. 105). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002, pp. 96, 98-106). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999, pp. 861-863; MBTSG 1998, p. 13; Rieman and McIntyre 1993, pp. 2-3). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger size fish with higher fecundity is lost (Rieman and McIntyre 1993, p. 2).

Whitesel et al. (2004, p. 2) noted that although there are multiple resources that contribute to the subject, Spruell et al. (2003, entire) best summarized genetic information on bull trout population structure. Spruell et al. (2003, entire) analyzed 1,847 bull trout from 65 sampling locations, four located in three coastal drainages (Klamath, Queets, and Skagit Rivers), one in the Saskatchewan River drainage (Belly River), and 60 scattered throughout the Columbia River Basin. They concluded that there is a consistent pattern among genetic studies of bull trout, regardless of whether examining allozymes, mitochondrial DNA, or most recently microsatellite loci. Typically, the genetic pattern shows relatively little genetic variation within populations, but substantial divergence among populations. Microsatellite loci analysis supports the existence of at least three major genetically differentiated groups (or evolutionary lineages) of bull trout (Spruell et al. 2003, p. 17). They were characterized as:

i. "Coastal", including the Deschutes River and all of the Columbia River drainage downstream, as well as most coastal streams in Washington, Oregon, and British Columbia. A compelling case also exists that the Klamath Basin represents a unique evolutionary lineage within the coastal group.

ii. "Snake River", which also included the John Day, Umatilla, and Walla Walla rivers. Despite close proximity of the John Day and Deschutes Rivers, a striking level of divergence between bull trout in these two systems was observed.

iii. "Upper Columbia River" which includes the entire basin in Montana and northern Idaho. A tentative assignment was made by Spruell et al. (2003, p. 25) of the Saskatchewan River drainage populations (east of the continental divide), grouping them with the upper Columbia River group.

Spruell et al. (2003, p. 17) noted that within the major assemblages, populations were further subdivided, primarily at the level of major river basins. Taylor et al. (1999, entire) surveyed bull trout populations, primarily from Canada, and found a major divergence between inland and coastal populations. Costello et al. (2003, p. 328) suggested the patterns reflected the existence of two glacial refugia, consistent with the conclusions of Spruell et al. (2003, p. 26) and the biogeographic analysis of Haas and McPhail (2001, entire). Both Taylor et al. (1999, p. 1166) and Spruell et al. (2003, p. 21) concluded that the Deschutes River represented the most upstream limit of the coastal lineage in the Columbia River Basin.

More recently, the U.S. Fish and Wildlife Service (Service) identified additional genetic units within the coastal and interior lineages (Ardren et al. 2011, p. 18). Based on a recommendation in the Service's 5-year review of the species' status (USFWS 2008a, p. 45), the Service reanalyzed the 27 recovery units identified in the draft bull trout recovery plan (USFWS 2002a, p. 48) by utilizing, in part, information from previous genetic studies and new information from additional analysis (Ardren et al. 2011, entire). In this examination, the Service applied relevant factors from the joint Service and National Marine Fisheries Service Distinct Population Segment (DPS) policy (USFWS 1996, entire) and subsequently identified six draft recovery units that contain assemblages of Core Areas that retain genetic and ecological integrity across the range of bull trout in the coterminous United States. These six draft recovery units were used to inform designation of critical habitat for bull trout by providing a context for deciding what habitats are essential for recovery (USFWS 2010a, p. 63898). The six draft recovery units identified for bull trout in the coterminous United States include: Coastal, Klamath, Mid-Columbia, Columbia Headwaters, Saint Mary, and Upper Snake. These six draft recovery units were also identified in the Service's revised recovery plan (USFWS 2015, p. vii) and designated as final recovery units.

Population Dynamics

Although bull trout are widely distributed over a large geographic area, they exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, p. 4). Increased habitat fragmentation reduces the amount of available habitat and increases isolation from other populations of the same species (Saunders et al. 1991, entire). Burkey (1989, entire) concluded that when species are isolated by fragmented habitats, low rates of population growth are typical in local populations and their probability of extinction is directly related to the degree of isolation and fragmentation. Without sufficient immigration, growth for local populations may be low and probability of extinction high (Burkey 1989, entire; Burkey 1995, entire).

Metapopulation concepts of conservation biology theory have been suggested relative to the distribution and characteristics of bull trout, although empirical evidence is relatively scant (Rieman and McIntyre 1993, p. 15; Dunham and Rieman 1999, entire; Rieman and Dunham 2000, entire). A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994, pp. 189-190). For inland bull trout, metapopulation theory is likely most applicable at the watershed scale where habitat consists of discrete patches or collections of habitat capable of supporting local populations; local populations are for the most part independent and represent discrete reproductive units; and long-term, low-rate dispersal patterns among component populations influences the persistence of at least some of the local populations (Rieman and Dunham 2000, entire). Ideally, multiple local populations distributed throughout a watershed provide a mechanism for spreading risk because the simultaneous loss of all local populations is unlikely. However, habitat alteration, primarily through the construction of impoundments, dams, and water diversions has fragmented habitats, eliminated migratory corridors, and in many cases isolated bull trout in the headwaters of tributaries (Rieman and Clayton 1997, pp. 10-12; Dunham and Rieman 1999, p. 645; Spruell et al. 1999, pp. 118-120; Rieman and Dunham 2000, p. 55).

Human-induced factors as well as natural factors affecting bull trout distribution have likely limited the expression of the metapopulation concept for bull trout to patches of habitat within the overall distribution of the species (Dunham and Rieman 1999, entire). However, despite the theoretical fit, the relatively recent and brief time period during which bull trout investigations have taken place does not provide certainty as to whether a metapopulation dynamic is occurring (e.g., a balance between local extirpations and recolonizations) across the range of the bull trout or whether the persistence of bull trout in large or closely interconnected habitat patches (Dunham and Rieman 1999, entire) is simply reflective of a general deterministic trend towards extinction of the species where the larger or interconnected patches are relics of historically wider distribution (Rieman and Dunham 2000, pp. 56-57). Recent research (Whiteley et al. 2003, entire) does, however, provide genetic evidence for the presence of a metapopulation process for bull trout, at least in the Boise River Basin of Idaho.

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, p. 4). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, entire; Goetz 1989, pp. 23, 25; Hoelscher and Bjornn 1989, pp. 19, 25; Howell and Buchanan 1992, pp. 30, 32; Pratt 1992, entire; Rich 1996, p. 17; Rieman and McIntyre 1993, pp. 4-6; Rieman and McIntyre 1995, entire; Sedell and Everest 1991, entire; Watson and Hillman 1997, entire). Watson and Hillman (1997, pp. 247-250) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, pp. 4-6), bull trout should not be expected to simultaneously occupy all available habitats.

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993, p. 2). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993, p. 2; Spruell et al. 1999, entire). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under "Diet."

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams, and spawning habitats are generally characterized by temperatures that drop below 9 °C in the fall (Fraley and Shepard 1989, p. 137; Pratt 1992, p. 5; Rieman and McIntyre 1993, p. 2).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992, pp 7-8; Rieman and McIntyre 1993, p. 7). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (Buchanan and Gregory 1997, p. 4; Goetz 1989, p. 22). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996, entire) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C, within a temperature gradient of 8 °C to 15 °C. In a landscape study relating bull trout distribution to maximum water temperatures, Dunham et al. (2003, p. 900) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C.

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997, p. 2; Fraley and Shepard 1989, pp. 133, 135; Rieman and McIntyre 1993, pp. 3-4; Rieman and McIntyre 1995, p. 287). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick 2002, pp. 6 and 13).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, p. 137; Goetz 1989, p. 19; Hoelscher and Bjornn 1989, p. 38; Pratt 1992, entire; Rich 1996, pp. 4-5; Sedell and Everest 1991, entire; Sexauer and James 1997, entire; Thomas 1992, pp. 4-6; Watson and Hillman 1997, p. 238). Maintaining bull trout habitat requires natural stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993, pp. 5-6). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, p. 364). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, p. 141; Pratt 1992, p. 6; Pratt and Huston 1993, p. 70). Pratt (1992, p. 6) indicated that increases in fine sediment reduce egg survival and emergence.

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Fish growth depends on the quantity and quality of food that is eaten, and as fish grow their foraging strategy changes as their food changes, in quantity, size, or other characteristics (Quinn 2005, pp. 195-200). Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, p. 58; Donald and Alger 1993, pp. 242-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout feed on various fish species (Donald and Alger 1993, pp. 241-243; Fraley and Shepard 1989, pp. 135, 138; Leathe and Graham 1982, pp. 13, 50-56). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and VanTassell 2001, p. 204). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004, p. 105; WDFW et al. 1997, p. 23).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997, p. 25). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005, pp. 1078-1079; Goetz et al. 2004, entire).

Status and Distribution

Distribution and Demography

The historical range of bull trout includes major river basins in the Pacific Northwest at about 41 to 60 degrees North latitude, from the southern limits in the McCloud River in northern California and the Jarbidge River in Nevada to the headwaters of the Yukon River in the Northwest Territories, Canada (Cavender 1978, pp. 165-166; Bond 1992, p. 2). To the west, the bull trout's range includes Puget Sound, various coastal rivers of British Columbia, Canada, and southeast Alaska (Bond 1992, p. 2). Bull trout occur in portions of the Columbia River and tributaries within the basin, including its headwaters in Montana and Canada. Bull trout also occur in the Klamath River basin of south-central Oregon. East of the Continental Divide, bull trout are found in the headwaters of the Saskatchewan River in Alberta and Montana and in the MacKenzie River system in Alberta and British Columbia, Canada (Cavender 1978, pp. 165-166; Brewin et al. 1997, entire).

Each of the following recovery units (below) is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions. No new local populations have been identified and no local populations have been lost since listing.

Coastal Recovery Unit

The Coastal Recovery Unit is located within western Oregon and Washington. Major geographic regions include the Olympic Peninsula, Puget Sound, and Lower Columbia River basins. The Olympic Peninsula and Puget Sound geographic regions also include their associated marine waters (Puget Sound, Hood Canal, Strait of Juan de Fuca, and Pacific Coast), which are critical in supporting the anadromous[1] life history form, unique to the Coastal Recovery Unit. The Coastal Recovery Unit is also the only unit that overlaps with the distribution of Dolly Varden (*Salvelinus malma*) (Ardren *et al.* 2011), another native char species that looks very similar to the bull trout (Haas and McPhail 1991). The two species have likely had some level of historic introgression in this part of their range (Redenbach and Taylor 2002). The Lower Columbia River major geographic region includes the lower mainstem Columbia River, an important migratory waterway essential for providing habitat and population connectivity within this region. In the Coastal Recovery Unit, there are 21 existing bull trout Core Areas which have been designated, including the recently reintroduced Clackamas River population, and 4 Core Areas have been identified that could be re-established. Core areas within the recovery unit are distributed among these three major geographic regions (Puget Sound also includes one Core Area that is actually part of the lower Fraser River system in British Columbia, Canada) (USFWS 2015a, p. A-1).

The current demographic status of bull trout in the Coastal Recovery Unit is variable across the unit. Populations in the Puget Sound region generally tend to have better demographic status, followed by the Olympic Peninsula, and finally the Lower Columbia River region. However, population strongholds do exist across the three regions. The Lower Skagit River and Upper Skagit River Core Areas in the Puget Sound region likely contain two of the most abundant bull trout populations with some of the most intact habitat within this recovery unit. The Lower Deschutes River Core Area in the Lower Columbia River region also contains a very abundant bull trout population and has been used as a donor stock for re-establishing the Clackamas River population (USFWS 2015a, p. A-6).

[1] Anadromous: Life history pattern of spawning and rearing in fresh water and migrating to salt water areas to mature.

Puget Sound Region

In the Puget Sound region, bull trout populations are concentrated along the eastern side of Puget Sound with most Core Areas concentrated in central and northern Puget Sound.

Although the Chilliwack River Core Area is considered part of this region, it is technically connected to the Fraser River system and is transboundary with British Columbia making its distribution unique within the region. Most Core Areas support a mix of anadromous and fluvial life history forms, with at least two Core Areas containing a natural adfluvial life history (Chilliwack River Core Area [Chilliwack Lake] and Chester Morse Lake Core Area). Overall demographic status of Core Areas generally improves as you move from south Puget Sound to north Puget Sound. Although comprehensive trend data are lacking, the current condition of Core Areas within this region are likely stable overall, although some at depressed abundances. Two Core Areas (Puyallup River and Stillaguamish River) contain local populations at either very low abundances (Upper Puyallup and Mowich Rivers) or that have likely become locally extirpated (Upper Deer Creek, South Fork Canyon Creek, and Greenwater River). Connectivity among and within Core Areas of this region is generally intact. Most Core Areas in this region still have significant amounts of headwater habitat within protected and relatively pristine areas (e.g., North Cascades National Park, Mount Rainier National Park, Skagit Valley Provincial Park, Manning Provincial Park, and various wilderness or recreation areas) (USFWS 2015a, p. A-7).

Olympic Peninsula Region

In the Olympic Peninsula region, distribution of Core Areas is somewhat disjunct, with only one located on the west side of Hood Canal on the eastern side of the peninsula, two along the Strait of Juan de Fuca on the northern side of the peninsula, and three along the Pacific Coast on the western side of the peninsula. Most Core Areas support a mix of anadromous and fluvial life history forms, with at least one Core Area also supporting a natural adfluvial life history (Quinault River Core Area [Quinault Lake]). Demographic status of Core Areas is poorest in Hood Canal and Strait of Juan de Fuca, while Core Areas along the Pacific Coast of Washington likely have the best demographic status in this region. The connectivity between Core Areas in these disjunct regions is believed to be naturally low due to the geographic distance between them.

Internal connectivity is currently poor within the Skokomish River Core Area (Hood Canal) and is being restored in the Elwha River Core Area (Strait of Juan de Fuca). Most Core Areas in this region still have their headwater habitats within relatively protected areas (Olympic National Park and wilderness areas) (USFWS 2015a, p. A-7).

Lower Columbia River Region

In the Lower Columbia River region, the majority of Core Areas are distributed along the Cascade Crest on the Oregon side of the Columbia River. Only two of the seven Core Areas in this region are in Washington. Most Core Areas in the region historically supported a fluvial life history form, but many are now adfluvial due to reservoir construction. However, there is at least one Core Area supporting a natural adfluvial life history (Odell Lake) and one supporting a natural, isolated, resident life history (Klickitat River [West Fork Klickitat]). Status is highly variable across this region, with one relative stronghold (Lower Deschutes Core Area) existing on the Oregon side of the Columbia River. The Lower Columbia River region also contains three watersheds (North Santiam River, Upper Deschutes River, and White Salmon River) that could potentially become re-established Core Areas within the Coastal Recovery Unit. Although the South Santiam River has been identified as a historic Core Area, there remains uncertainty as to whether or not historical observations of bull trout represented a self-sustaining population. Current habitat conditions in the South Santiam River are thought to be unable to support bull trout spawning and rearing. Adult abundances within the majority of Core Areas in this region are relatively low, generally 300 or fewer individuals.

Most core populations in this region are not only isolated from one another due to dams or natural barriers, but they are internally fragmented as a result of manmade barriers. Local populations are often disconnected from one another or from potential foraging habitat. In the Coastal Recovery Unit, adult abundance may be lowest in the Hood River and Odell Lake Core Areas, which each contain fewer than 100 adults. Bull trout were reintroduced in the Middle Fork Willamette River in 1990 above Hills Creek Reservoir. Successful reproduction was first documented in 2006, and has occurred each year since (USFWS 2015a, p. A-8). Natural reproducing populations of bull trout are present in the McKenzie River basin (USFWS 2008d, pp. 65-67). Bull trout were more recently reintroduced into the Clackamas River basin in the summer of 2011 after an extensive feasibility analysis (Shively et al. 2007, Hudson et al. 2015). Bull trout from the Lower Deschutes Core Area are being utilized for this reintroduction effort (USFWS 2015a, p. A-8).

Klamath Recovery Unit

Bull trout in the Klamath Recovery Unit have been isolated from other bull trout populations for the past 10,000 years and are recognized as evolutionarily and genetically distinct (Minckley et al. 1986; Leary et al. 1993; Whitesel et al. 2004; USFWS 2008a; Ardren et al. 2011). As such, there is no opportunity for bull trout in another recovery unit to naturally re- colonize the Klamath Recovery Unit if it were to become extirpated. The Klamath Recovery Unit lies at the southern edge of the species range and occurs in an arid portion of the range of bull trout.

Bull trout were once widespread within the Klamath River basin (Gilbert 1897; Dambacher et al. 1992; Ziller 1992; USFWS 2002b), but habitat degradation and fragmentation, past and present land use practices, agricultural water diversions, and past fisheries management practices have greatly reduced their distribution. Bull trout abundance also has been severely reduced, and the remaining populations are highly fragmented and vulnerable to natural or manmade factors that place them at a high risk of extirpation (USFWS 2002b). The presence of nonnative brook trout (*Salvelinus fontinalis*), which compete and hybridize with bull trout, is a particular threat to bull trout persistence throughout the Klamath Recovery Unit (USFWS 2015b, pp. B-3-4).

<u>*Upper Klamath Lake Core Area*</u>

The Upper Klamath Lake Core Area comprises two bull trout local populations (Sun Creek and Threemile Creek). These local populations likely face an increased risk of extirpation because they are isolated and not interconnected with each other. Extirpation of other local populations in the Upper Klamath Lake Core Area has occurred in recent times (1970s). Populations in this Core Area are genetically distinct from those in the other two Core Areas in the Klamath Recovery Unit (USFWS 2008b), and in comparison, genetic variation within this Core Area is lowest. The two local populations have been isolated by habitat fragmentation and have experienced population bottlenecks. As such, currently unoccupied habitat is needed to restore connectivity between the two local populations and to establish additional populations. This unoccupied habitat includes canals, which now provide the only means of connectivity as migratory corridors. Providing full volitional connectivity for bull trout, however, also introduces the risk of invasion by brook trout, which are abundant in this Core Area.

Bull trout in the Upper Klamath Lake Core Area formerly occupied Annie Creek, Sevenmile Creek, Cherry Creek, and Fort Creek, but are now extirpated from these locations. The last remaining local populations, Sun Creek and Threemile Creek, have received focused attention. Brook trout have been removed from bull trout occupied reaches, and these reaches have been intentionally isolated to prevent brook trout reinvasion. As such, over the past few generations these populations have become stable and have increased in distribution and abundance. In 1996, the Threemile Creek population had approximately 50 fish that occupied a 1.4-km (0.9-mile) reach (USFWS 2002b). In 2012, a mark-resight population estimate was completed in Threemile Creek, which indicated an abundance of 577 (95 percent confidence interval = 475 to 679) age-1+ fish (ODFW 2012). In addition, the length of the distribution of bull trout in Threemile Creek had increased to 2.7 km (1.7 miles) by 2012 (USFWS unpublished data). Between 1989 and 2010, bull trout abundance in Sun Creek increased approximately tenfold (from approximately 133 to 1,606 age-1+ fish) and distribution increased from approximately 1.9 km (1.2 miles) to 11.2 km (7.0 miles) (Buktenica et al. 2013) (USFWS 2015b, p. B-5).

<u>*Sycan River Core Area*</u>

The Sycan River Core Area is comprised of one local population, Long Creek. Long Creek likely faces greater risk of extirpation because it is the only remaining local population due to extirpation of all other historic local populations. Bull trout previously occupied Calahan Creek, Coyote Creek, and the Sycan River, but are now extirpated from these locations (Light et al. 1996). This Core Area's local population is genetically distinct from those in the other two Core Areas (USFWS 2008b). This Core Area also is essential for recovery because bull trout in this Core Area exhibit both resident[2] and fluvial life histories, which are important for representing diverse life history expression in the Klamath Recovery Unit. Migratory bull trout are able to grow larger than their resident counterparts, resulting in greater fecundity and higher reproductive potential (Rieman and McIntyre 1993). Migratory life history forms also have been shown to be important for population persistence and resilience (Dunham et al. 2008).

The last remaining population (Long Creek) has received focused attention in an effort to ensure it is not also extirpated. In 2006, two weirs were removed from Long Creek, which increased the amount of occupied foraging, migratory, and overwintering (FMO) habitat by 3.2 km (2.0 miles). Bull trout currently occupy approximately 3.5 km (2.2 miles) of spawning/rearing habitat, including a portion of an unnamed tributary to upper Long Creek, and seasonally use 25.9 km (16.1 miles) of FMO habitat. Brook trout also inhabit Long Creek and have been the focus of

[2] Resident: Life history pattern of residing in tributary streams for the fish's entire life without migrating.

periodic removal efforts. No recent statistically rigorous population estimate has been completed for Long Creek; however, the 2002 Draft Bull Trout Recovery Plan reported a population estimate of 842 individuals (USFWS 2002b). Currently unoccupied habitat is needed to establish additional local populations, although brook trout are widespread in this Core Area and their management will need to be considered in future recovery efforts. In 2014, the Klamath Falls Fish and Wildlife Office of the Service established an agreement with the U.S. Geological Survey to undertake a structured decision making process to assist with recovery planning of bull trout populations in the Sycan River Core Area (USFWS 2015b, p. B-6).

Upper Sprague River Core Area

The Upper Sprague River Core Area comprises five bull trout local populations, placing the Core Area at an intermediate risk of extinction. The five local populations include Boulder Creek, Dixon Creek, Deming Creek, Leonard Creek, and Brownsworth Creek. These local populations may face a higher risk of extirpation because not all are interconnected. Bull trout local populations in this Core Area are genetically distinct from those in the other two Klamath Recovery Unit Core Areas (USFWS 2008b). Migratory bull trout have occasionally been observed in the North Fork Sprague River (USFWS 2002b). Therefore, this Core Area also is essential for recovery in that bull trout here exhibit a resident life history and likely a fluvial life history, which are important for conserving diverse life history expression in the Klamath Recovery Unit as discussed above for the Sycan River Core Area.

The Upper Sprague River Core Area population of bull trout has experienced a decline from historic levels, although less is known about historic occupancy in this Core Area. Bull trout are reported to have historically occupied the South Fork Sprague River, but are now extirpated from this location (Buchanan et al. 1997). The remaining five populations have received focused attention. Although brown trout (*Salmo trutta*) co-occur with bull trout and exist in adjacent habitats, brook trout do not overlap with existing bull trout populations. Efforts have been made to increase connectivity of existing bull trout populations by replacing culverts that create barriers. Thus, over the past few generations, these populations have likely been stable and increased in distribution. Population abundance has been estimated recently for Boulder Creek (372 + 62 percent; Hartill and Jacobs 2007), Dixon Creek (20 + 60 percent; Hartill and Jacobs 2007), Deming Creek (1,316 + 342; Moore 2006), and Leonard Creek (363 + 37 percent; Hartill and Jacobs 2007). No statistically rigorous population estimate has been completed for the Brownsworth Creek local population; however, the 2002 Draft Bull Trout Recovery Plan reported a population estimate of 964 individuals (USFWS 2002b). Additional local populations need to be established in currently unoccupied habitat within the Upper Sprague River Core Area, although brook trout are widespread in this Core Area and will need to be considered in future recovery efforts (USFWS 2015b, p. B-7).

Mid-Columbia Recovery Unit

The Mid-Columbia Recovery Unit (RU) comprises 24 bull trout Core Areas, as well as 2 historically occupied Core Areas and 1 research needs area. The Mid-Columbia RU is recognized as an area where bull trout have co-evolved with salmon, steelhead, lamprey, and other fish populations. Reduced fish numbers due to historic overfishing and land management changes have caused changes in nutrient abundance for resident migratory fish like the bull trout.

The recovery unit is located within eastern Washington, eastern Oregon, and portions of central Idaho. Major drainages include the Methow River, Wenatchee River, Yakima River, John Day River, Umatilla River, Walla Walla River, Grande Ronde River, Imnaha River, Clearwater River, and smaller drainages along the Snake River and Columbia River (USFWS 2015c, p. C-1).

The Mid-Columbia RU can be divided into four geographic regions the Lower Mid-Columbia, which includes all Core Areas that flow into the Columbia River below its confluence with the 1) Snake River; 2) the Upper Mid-Columbia, which includes all Core Areas that flow into the Columbia River above its confluence with the Snake River; 3) the lower Snake, which includes all Core Areas that flow into the Snake River between its confluence with the Columbia River and Hells Canyon Dam; and 4) the Mid-Snake, which includes all Core Areas in the Mid-Columbia RU that flow into the Snake River above Hells Canyon Dam. These geographic regions are composed of neighboring Core Areas that share similar bull trout genetic, geographic (hydrographic), and/or habitat characteristics. Conserving bull trout in geographic regions allows for the maintenance of broad representation of genetic diversity, provides neighboring Core Areas with potential source populations in the event of local extirpations, and provides a broad array of options among neighboring Core Areas to contribute recovery under uncertain environmental change USFWS 2015c, pp. C-1-2).

The current demographic status of bull trout in the Mid-Columbia Recovery Unit is highly variable at both the RU and geographic region scale. Some Core Areas, such as the Umatilla, Asotin, and Powder Rivers, contain populations so depressed they are likely suffering from the deleterious effects of small population size. Conversely, strongholds do exist within the recovery unit, predominantly in the lower Snake geographic area. Populations in the Imnaha, Little Minam, Clearwater, and Wenaha Rivers are likely some of the most abundant. These populations are all completely or partially within the bounds of protected wilderness areas and have some of the most intact habitat in the recovery unit. Status in some Core Areas is relatively unknown, but all indications in these Core Areas suggest population trends are declining, particularly in the Core Areas of the John Day Basin (USFWS 2015c, p. C-5).

Lower Mid-Columbia Region

In the Lower Mid-Columbia Region, Core Areas are distributed along the western portion of the Blue Mountains in Oregon and Washington. Only one of the six Core Areas is located completely in Washington. Demographic status is highly variable throughout the region. Status is the poorest in the Umatilla and Middle Fork John Day Core Areas. However, the Walla Walla River Core Area contains nearly pristine habitats in the headwater spawning areas and supports the most abundant populations in the region. Most Core Areas support both a resident and fluvial life history; however, recent evidence suggests a significant decline in the resident and fluvial life history in the Umatilla River and John Day Core Areas respectively. Connectivity between the Core Areas of the Lower Mid-Columbia Region is unlikely given conditions in the connecting FMO habitats. Connection between the Umatilla, Walla Walla and Touchet Core Areas is uncommon but has been documented, and connectivity is possible between Core Areas in the John Day Basin. Connectivity between the John Day Core Areas and Umatilla/Walla Walla/Touchet Core Areas is unlikely (USFWS 2015c, pp. C-5-6).

<u>*Upper Mid-Columbia Region*</u>

In the Upper Mid-Columbia Region, Core Areas are distributed along the eastern side of the Cascade Mountains in Central Washington. This area contains four Core Areas (Yakima, Wenatchee, Entiat, and Methow), the Lake Chelan historic Core Area, and the Chelan River, Okanogan River, and Columbia River FMO areas. The Core Area populations are generally considered migratory, though they currently express both migratory (fluvial and adfluvial) and resident forms. Residents are located both above and below natural barriers (*i.e.*, Early Winters Creek above a natural falls; and Ahtanum in the Yakima likely due to long lack of connectivity from irrigation withdrawal). In terms of uniqueness and connectivity, the genetics baseline, radio-telemetry, and PIT tag studies identified unique local populations in all Core Areas. Movement patterns within the Core Areas; between the lower river, lakes, and other Core Areas; and between the Chelan, Okanogan, and Columbia River FMO occurs regularly for some of the Wenatchee, Entiat, and Methow Core Area populations. This type of connectivity has been displayed by one or more fish, typically in non-spawning movements within FMO. More recently, connectivity has been observed between the Entiat and Yakima Core Areas by a juvenile bull trout tagged in the Entiat moving in to the Yakima at Prosser Dam and returning at an adult size back to the Entiat. Genetics baselines identify unique populations in all four Core Areas (USFWS 2015c, p. C-6).

The demographic status is variable in the Upper-Mid Columbia region and ranges from good to very poor. The Service's 2008 5-year Review and Conservation Status Assessment described the Methow and Yakima Rivers at risk, with a rapidly declining trend. The Entiat River was listed at risk with a stable trend, and the Wenatchee River as having a potential risk, and with a stable trend. Currently, the Entiat River is considered to be declining rapidly due to much reduced redd counts. The Wenatchee River is able to exhibit all freshwater life histories with connectivity to Lake Wenatchee, the Wenatchee River and all its local populations, and to the Columbia River and/or other Core Areas in the region. In the Yakima Core Area some populations exhibit life history forms different from what they were historically. Migration between local populations and to and from spawning habitat is generally prevented or impeded by headwater storage dams on irrigation reservoirs, connectivity between tributaries and reservoirs, and within lower portions of spawning and rearing habitat and the mainstem Yakima River due to changed flow patterns, low instream flows, high water temperatures, and other habitat impediments. Currently, the connectivity in the Yakima Core area is truncated to the degree that not all populations are able to contribute gene flow to a functional metapopulation (USFWS 2015c, pp. C-6-7).

<u>*Lower Snake Region*</u>

Demographic status is variable within the lower Snake Region. Although trend data are lacking, several Core Areas in the Grande Ronde Basin and the Imnaha Core Area are thought to be stable. The upper Grande Ronde Core Area is the exception where population abundance is considered depressed (USFWS 2015c, p. C-7). Wenaha, Little Minam, and Imnaha Rivers are strongholds (as mentioned above), as are most Core Areas in the Clearwater River basin. Most Core Areas contain populations that express both a resident and fluvial life history strategy. There is potential that some bull trout in the upper Wallowa River are adfluvial. There is potential for connectivity between Core Areas in the Grande Ronde basin, however conditions in FMO are limiting (USFWS 2015c, p. C-7).

Middle Snake Region

In the Middle Snake Region, Core Areas are distributed along both sides of the Snake River above Hells Canyon Dam. The Powder River and Pine Creek basins are in Oregon and Indian Creek and Wildhorse Creek are on the Idaho side of the Snake River. Demographic status of the Core Areas is poorest in the Powder River Core Area where populations are highly fragmented and severely depressed (USFWS 2015c, p. C-7). The East Pine Creek population in the Pine-Indian-Wildhorse Creeks Core Area is likely the most abundant within the region. Populations in both Core Areas primarily express a resident life history strategy; however, some evidence suggests a migratory life history still exists in the Pine-Indian-Wildhorse Creeks Core Area. Connectivity is severely impaired in the Middle Snake Region. Dams, diversions and temperature barriers prevent movement among populations and between Core Areas. Brownlee Dam isolates bull trout in Wildhorse Creek from other populations (USFWS 2015c, p. C-7).

Columbia Headwaters Recovery Unit

The Columbia Headwaters Recovery Unit (CHRU) includes western Montana, northern Idaho, and the northeastern corner of Washington. Major drainages include the Clark Fork River basin and its Flathead River contribution, the Kootenai River basin, and the Coeur d'Alene Lake basin. In this implementation plan for the CHRU we have slightly reorganized the structure from the 2002 Draft Recovery Plan, based on latest available science and fish passage improvements that have rejoined previously fragmented habitats. We now identify 35 bull trout Core Areas (compared to 47 in 2002) for this recovery unit. Fifteen of the 35 are referred to as "complex" Core Areas as they represent large interconnected habitats, each containing multiple spawning streams considered to host separate and largely genetically identifiable local populations. The 15 complex Core Areas contain the majority of individual bull trout and the bulk of the designated critical habitat (USFWS 2010b).

However, somewhat unique to this recovery unit is the additional presence of 20 smaller Core Areas, each represented by a single local population. These "simple" Core Areas are found in remote glaciated headwater basins, often in Glacier National Park or federally-designated wilderness areas, but occasionally also in headwater valley bottoms. Many simple Core Areas are upstream of waterfalls or other natural barriers to fish migration. In these simple Core Areas bull trout have apparently persisted for thousands of years despite small populations and isolated existence. As such, simple Core Areas meet the criteria for Core Area designation and continue to be valued for their uniqueness, despite limitations of size and scope. Collectively, the 20 simple Core Areas contain less than 3 percent of the total bull trout Core Area habitat in the CHRU, but represent significant genetic and life history diversity (Meeuwig et al. 2010). Throughout this recovery unit implementation plan, we often separate our analyses to distinguish between complex and simple Core Areas, both in respect to threats as well as recovery actions (USFWS 2015d, pp. D-1-2).

In order to effectively manage the recovery unit implementation plan (RUIP) structure in this large and diverse landscape, the Core Areas have been separated into the following five natural geographic assemblages.

Upper Clark Fork Geographic Region

Starting at the Clark Fork River headwaters, the *Upper Clark Fork Geographic Region* comprises seven complex Core Areas, each of which occupies one or more major watersheds contributing to the Clark Fork basin (*i.e*., Upper Clark Fork River, Rock Creek, Blackfoot River, Clearwater River and Lakes, Bitterroot River, West Fork Bitterroot River, and Middle Clark Fork River Core Areas) (USFWS 2015d, p. D-2).

Lower Clark Fork Geographic Region

The seven headwater Core Areas flow into the *Lower Clark Fork Geographic Region*, which comprises two complex Core Areas, Lake Pend Oreille and Priest Lake. Because of the systematic and jurisdictional complexity (three States and a Tribal entity) and the current degree of migratory fragmentation caused by five mainstem dams, the threats and recovery actions in the Lake Pend Oreille (LPO) Core Area are very complex and are described in three parts. LPO-A is upstream of Cabinet Gorge Dam, almost entirely in Montana, and includes the mainstem Clark Fork River upstream to the confluence of the Flathead River as well as the portions of the lower Flathead River (*e.g.*, Jocko River) on the Flathead Indian Reservation. LPO-B is the Pend Oreille lake basin proper and its tributaries, extending between Albeni Falls Dam downstream from the outlet of Lake Pend Oreille and Cabinet Gorge Dam just upstream of the lake; almost entirely in Idaho. LPO-C is the lower basin (*i.e*., lower Pend Oreille River), downstream of Albeni Falls Dam to Boundary Dam (1 mile upstream from the Canadian border) and bisected by Box Canyon Dam; including portions of Idaho, eastern Washington, and the Kalispel Reservation (USFWS 2015d, p. D-2).

Historically, and for current purposes of bull trout recovery, migratory connectivity among these separate fragments into a single entity remains a primary objective.

Flathead Geographic Region

The *Flathead Geographic Region* includes a major portion of northwestern Montana upstream of Kerr Dam on the outlet of Flathead Lake. The complex Core Area of Flathead Lake is the hub of this area, but other complex Core Areas isolated by dams are Hungry Horse Reservoir (formerly South Fork Flathead River) and Swan Lake. Within the glaciated basins of the Flathead River headwaters are 19 simple Core Areas, many of which lie in Glacier National Park or the Bob Marshall and Great Bear Wilderness areas and some of which are isolated by natural barriers or other features (USFWS 2015d, p. D-2).

Kootenai Geographic Region

To the northwest of the Flathead, in an entirely separate watershed, lies the *Kootenai Geographic Region*. The Kootenai is a uniquely patterned river system that originates in southeastern British Columbia, Canada. It dips, in a horseshoe configuration, into northwest Montana and north Idaho before turning north again to re-enter British Columbia and eventually join the Columbia River headwaters in British Columbia. The *Kootenai Geographic Region* contains two complex Core Areas (Lake Koocanusa and the Kootenai River) bisected since the 1970’s by Libby Dam, and also a single naturally isolated simple Core Area (Bull Lake). Bull trout in both of the complex Core Areas retain strong migratory connections to populations in British Columbia (USFWS 2015d, p. D-3).

Coeur d'Alene Geographic Region

Finally, the *Coeur d'Alene Geographic Region* consists of a single, large complex Core Area centered on Coeur d'Alene Lake. It is grouped into the CHRU for purposes of physical and ecological similarity (adfluvial bull trout life history and nonanadromous linkage) rather than due to watershed connectivity with the rest of the CHRU, as it flows into the mid-Columbia River far downstream of the Clark Fork and Kootenai systems (USFWS 2015d, p. D-3).

Upper Snake Recovery Unit

The Upper Snake Recovery Unit includes portions of central Idaho, northern Nevada, and eastern Oregon. Major drainages include the Salmon River, Malheur River, Jarbidge River, Little Lost River, Boise River, Payette River, and the Weiser River. The Upper Snake Recovery Unit contains 22 bull trout Core Areas within 7 geographic regions or major watersheds: Salmon River (10 Core Areas, 123 local populations), Boise River (2 Core Areas, 29 local populations), Payette River (5 Core Areas, 25 local populations), Little Lost River (1 Core Area, 10 local populations), Malheur River (2 Core Areas, 8 local populations), Jarbidge River (1 Core Area, 6 local populations), and Weiser River (1 Core Area, 5 local populations). The Upper Snake Recovery Unit includes a total of 206 local populations, with almost 60 percent being present in the Salmon River watershed (USFWS 2015e, p. E-1).

Three major bull trout life history expressions are present in the Upper Snake Recovery Unit, adfluvial[3], fluvial[4], and resident populations. Large areas of intact habitat exist primarily in the Salmon drainage, as this is the only drainage in the Upper Snake Recovery Unit that still flows directly into the Snake River; most other drainages no longer have direct connectivity due to irrigation uses or instream barriers. Bull trout in the Salmon basin share a genetic past with bull trout elsewhere in the Upper Snake Recovery Unit. Historically, the Upper Snake Recovery Unit is believed to have largely supported the fluvial life history form; however, many Core Areas are now isolated or have become fragmented watersheds, resulting in replacement of the fluvial life history with resident or adfluvial forms. The Weiser River, Squaw Creek, Pahsimeroi River, and North Fork Payette River Core Areas contain only resident populations of bull trout (USFWS 2015e, pp. E-1-2).

Salmon River

The Salmon River basin represents one of the few basins that are still free-flowing down to the Snake River. The Core Areas in the Salmon River basin do not have any major dams and a large extent (approximately 89 percent) is federally managed, with large portions of the Middle Fork Salmon River and Middle Fork Salmon River - Chamberlain Core Areas occurring within the Frank Church River of No Return Wilderness. Most Core Areas in the Salmon River basin

[3] Adfluvial: Life history pattern of spawning and rearing in tributary streams and migrating to lakes or reservoirs to mature.
[4] Fluvial: Life history pattern of spawning and rearing in tributary streams and migrating to larger rivers to mature.

contain large populations with many occupied stream segments. The Salmon River basin contains 10 of the 22 Core Areas in the Upper Snake Recovery Unit and contains the majority of the occupied habitat. Over 70 percent of occupied habitat in the Upper Snake Recovery Unit occurs in the Salmon River basin as well as 123 of the 206 local populations. Connectivity between Core Areas in the Salmon River basin is intact; therefore it is possible for fish in the mainstem Salmon to migrate to almost any Salmon River Core Area or even the Snake River.

Connectivity within Salmon River basin Core Areas is mostly intact except for the Pahsimeroi River and portions of the Lemhi River. The Upper Salmon River, Lake Creek, and Opal Lake Core Areas contain adfluvial populations of bull trout, while most of the remaining Core Areas contain fluvial populations; only the Pahsimeroi contains strictly resident populations. Most Core Areas appear to have increasing or stable trends but trends are not known in the Pahsimeroi, Lake Creek, or Opal Lake Core Areas. The Idaho Department of Fish and Game reported trend data from 7 of the 10 Core Areas. This trend data indicated that populations were stable or increasing in the Upper Salmon River, Lemhi River, Middle Salmon River-Chamberlain, Little Lost River, and the South Fork Salmon River (IDFG 2005, 2008). Trends were stable or decreasing in the Little-Lower Salmon River, Middle Fork Salmon River, and the Middle Salmon River-Panther (IDFG 2005, 2008).

Boise River

In the Boise River basin, two large dams are impassable barriers to upstream fish movement: Anderson Ranch Dam on the South Fork Boise River, and Arrowrock Dam on the mainstem Boise River. Fish in Anderson Ranch Reservoir have access to the South Fork Boise River upstream of the dam. Fish in Arrowrock Reservoir have access to the North Fork Boise River, Middle Fork Boise River, and lower South Fork Boise River. The Boise River basin contains 2 of the 22 Core Areas in the Upper Snake Recovery Unit. The Core Areas in the Boise River basin account for roughly 12 percent of occupied habitat in the Upper Snake Recovery Unit and contain 29 of the 206 local populations. Approximately 90 percent of both Arrowrock and Anderson Ranch Core Areas are federally owned; most lands are managed by the U.S. Forest Service, with some portions occurring in designated wilderness areas. Both the Arrowrock Core Area and the Anderson Ranch Core Area are isolated from other Core Areas. Both Core Areas contain fluvial bull trout that exhibit adfluvial characteristics and numerous resident populations. The Idaho Department of Fish and Game in 2014 determined that the Anderson Ranch Core Area had an increasing trend while trends in the Arrowrock Core Area is unknown (USFWS 2015e).

Payette River

The Payette River basin contains three major dams that are impassable barriers to fish: Deadwood Dam on the Deadwood River, Cascade Dam on the North Fork Payette River, and Black Canyon Reservoir on the Payette River. Only the Upper South Fork Payette River and the Middle Fork Payette River still have connectivity, the remaining Core Areas are isolated from each other due to dams. Both fluvial and adfluvial life history expression are still present in the Payette River basin but only resident populations are present in the Squaw Creek and North Fork Payette River Core Areas. The Payette River basin contains 5 of the 22 Core Areas and 25 of the 206 local populations in the recovery unit. Less than 9 percent of occupied habitat in the recovery unit is in this basin. Approximately 60 percent of the lands in the Core Areas are federally owned and the majority is managed by the U.S. Forest Service. Trend data are lacking and the current condition of the various Core Areas is unknown, but there is concern due to the current isolation of three (North Fork Payette River, Squaw Creek, Deadwood River) of the five Core Areas; the presence of only resident local populations in two (North Fork Payette River, Squaw Creek) of the five Core Areas; and the relatively low numbers present in the North Fork Core Area (USFWS 2015e, p. E-8).

Jarbidge River

The Jarbidge River Core Area contains two major fish barriers along the Bruneau River: the Buckaroo diversion and C. J. Strike Reservoir. Bull trout are not known to migrate down to the Snake River. There is one Core Area in the basin, with populations in the Jarbidge River; this watershed does not contain any barriers. Approximately 89 percent of the Jarbidge Core Area is federally owned. Most lands are managed by either the Forest Service or Bureau of Land Management. A large portion of the Core Area is within the Bruneau-Jarbidge Wilderness area. A tracking study has documented bull trout population connectivity among many of the local populations, in particular between West Fork Jarbidge River and Pine Creek. Movement between the East and West Fork Jarbidge River has also been documented; therefore, both resident and fluvial populations are present. The Core Area contains six local populations and 3 percent of the occupied habitat in the recovery unit. Trend data are lacking within this Core Area (USFWS 2015e, p. E-9).

Little Lost River

The Little Lost River basin is unique in that the watershed is within a naturally occurring hydrologic sink and has no connectivity with other drainages. A small fluvial population of bull trout may still exist, but it appears that most populations are predominantly resident populations. There is one Core Area in the Little Lost basin, and approximately 89 percent of it is federally owned by either the U.S. Forest Service or Bureau of Land Management. The Core Area contains 10 local populations and less than 3 percent of the occupied habitat in the recovery unit. The current trend condition of this Core Area is likely stable, with most bull trout residing in Upper Sawmill Canyon (IDFG 2014).

Malheur River

The Malheur River basin contains major dams that are impassable to fish. The largest are Warm Springs Dam, impounding Warm Springs Reservoir on the mainstem Malheur River, and Agency Valley Dam, impounding Beulah Reservoir on the North Fork Malheur River. The dams result in two Core Areas that are isolated from each other and from other Core Areas. Local populations in the two Core Areas are limited to habitat in the upper watersheds. The Malheur River basin contains 2 of the 22 Core Areas and 8 of the 206 local populations in the recovery unit. Fluvial and resident populations are present in both Core Areas while adfluvial populations are present in the North Fork Malheur River. This basin contains less than 3 percent of the occupied habitat in the recovery unit, and approximately 60 percent of lands in the two Core Areas are federally owned. Trend data indicates that populations are declining in both Core Areas (USFWS 2015e, p. E-9).

Weiser River

The Weiser River basin contains local populations that are limited to habitat in the upper watersheds. The Weiser River basin contains only a single Core Area that consists of 5 of the 206 local populations in the recovery unit. Local populations occur in only three stream complexes in the upper watershed: 1) Upper Hornet Creek, 2) East Fork Weiser River, and 3) Upper Little Weiser River. These local populations include only resident life histories. This basin contains less than 2 percent of the occupied habitat in the recovery unit, and approximately 44 percent of lands are federally owned. Trend data from the Idaho Department of Fish and Game indicate that the populations in the Weiser Core Area are increasing (IDFG 2014) but it is considered vulnerable because local populations are isolated and likely do not express migratory life histories (USFWS 2015e, p.E-10).

St. Mary Recovery Unit

The Saint Mary Recovery Unit is located in northwest Montana east of the Continental Divide and includes the U.S. portions of the Saint Mary River basin, from its headwaters to the international boundary with Canada at the 49th parallel. The watershed and the bull trout population are linked to downstream aquatic resources in southern Alberta, Canada; the U.S. portion includes headwater spawning and rearing (SR) habitat in the tributaries and a portion of the FMO habitat in the mainstem of the Saint Mary River and Saint Mary lakes (Mogen and Kaeding 2001).

The Saint Mary Recovery Unit comprises four Core Areas; only one (Saint Mary River) is a complex Core Area with five described local bull trout populations (Divide, Boulder, Kennedy, Otatso, and Lee Creeks). Roughly half of the linear extent of available FMO habitat in the mainstem Saint Mary system (between Saint Mary Falls at the upstream end and the downstream Canadian border) is comprised of Saint Mary and Lower Saint Mary Lakes, with the remainder in the Saint Mary River. The other three Core Areas (Slide Lakes, Cracker Lake, and Red Eagle Lake) are simple Core Areas. Slide Lakes and Cracker Lake occur upstream of seasonal or permanent barriers and are comprised of genetically isolated single local bull trout populations, wholly within Glacier National Park, Montana. In the case of Red Eagle Lake, physical isolation does not occur, but consistent with other lakes in the adjacent Columbia Headwaters Recovery Unit, there is likely some degree of spatial separation from downstream Saint Mary Lake. As noted, the extent of isolation has been identified as a research need (USFWS 2015f, p. F-1).

Bull trout in the Saint Mary River complex Core Area are documented to exhibit primarily the migratory fluvial life history form (Mogen and Kaeding 2005a, 2005b), but there is doubtless some occupancy (though less well documented) of Saint Mary Lakes, suggesting a partly adfluvial adaptation. Since lake trout and northern pike are both native to the Saint Mary River system (headwaters of the South Saskatchewan River drainage draining to Hudson Bay), the conventional wisdom is that these large piscivores historically outcompeted bull trout in the lacustrine environment (Donald and Alger 1993, Martinez et al. 2009), resulting in a primarily fluvial niche and existence for bull trout in this system. This is an untested hypothesis and additional research into this aspect is needed (USFWS 2015f, p. F-3).

Bull trout populations in the simple Core Areas of the three headwater lake systems (Slide, Cracker, and Red Eagle Lakes) are, by definition, adfluvial; there are also resident life history components in portions of the Saint Mary River system such as Lower Otatso Creek (Mogen and Kaeding 2005a), further exemplifying the overall life history diversity typical of bull trout. Mogen and Kaeding (2001) reported that bull trout continue to inhabit nearly all suitable habitats accessible to them in the Saint Mary River basin in the United States. The possible exception is portions of Divide Creek, which appears to be intermittently occupied despite a lack of permanent migratory barriers, possibly due to low population size and erratic year class production (USFWS 2015f, p. F-3).

It should be noted that bull trout are found in minor portions of two additional U.S. watersheds (Belly and Waterton rivers) that were once included in the original draft recovery plan (USFWS 2002) but are no longer considered Core Areas in the final recovery plan (USFWS 2015) and are not addressed in that document. In Alberta, Canada, the Saint Mary River bull trout population is considered at “high risk,” while the Belly River is rated as “at risk” (ACA 2009). In the Belly River drainage, which enters the South Saskatchewan system downstream of the Saint Mary River in Alberta, some bull trout spawning is known to occur on either side of the international boundary. These waters are in the drainage immediately west of the Saint Mary River headwaters. However, the U.S. range of this population constitutes only a minor headwater migratory SR segment of an otherwise wholly Canadian population, extending less than 1 mile (0.6 km) into backcountry waters of Glacier National Park. The Belly River population is otherwise totally dependent on management within Canadian jurisdiction, with no natural migratory connection to the Saint Mary (USFWS 2015f, p. F-3).

Current status of bull trout in the Saint Mary River Core Area (U.S.) is considered strong (Mogen 2013). Migratory bull trout redd counts are conducted annually in the two major SR streams, Boulder and Kennedy creeks. Boulder Creek redd counts have ranged from 33 to 66 in the past decade, with the last 4 counts all 53 or higher. Kennedy Creek redd counts are less robust, ranging from 5 to 25 over the last decade, with a 2014 count of 20 (USFWS 2015f, p. F-3).

Generally, the demographic status of the Saint Mary River Core Area is believed to be good, with the exception of the Divide Creek local population. In this local population, there is evidence that a combination of ongoing habitat manipulation (Smillie and Ellerbroek 1991, F-5 NPS 1992) resulting in occasional historical passage issues, combined with low and erratic recruitment (DeHaan et al. 2011) has caused concern for the continuing existence of the local population.

While less is known about the demographic status of the three simple cores where redd counts are not conducted, all three appear to be self-sustaining and fluctuating within known historical population demographic bounds. Of the three simple Core Areas, demographic status in Slide Lakes and Cracker Lake appear to be functioning appropriately, but the demographic status in Red Eagle Lake is less well documented and believed to be less robust (USFWS 2015f, p. F-3).

Reasons for Listing

Bull trout distribution, abundance, and habitat quality have declined rangewide (Bond 1992, pp. 2-3; Schill 1992, p. 42; Thomas 1992, entire; Ziller 1992, entire; Rieman and McIntyre 1993, p. 1; Newton and Pribyl 1994, pp. 4-5; McPhail and Baxter 1996, p. 1). Several local extirpations have been documented, beginning in the 1950s (Rode 1990, pp. 26-32; Ratliff and Howell 1992, entire; Donald and Alger 1993, entire; Goetz 1994, p. 1; Newton and Pribyl 1994, pp. 8-9; Light et al. 1996, pp. 6-7; Buchanan et al. 1997, p. 15; WDFW 1998, pp. 2-3). Bull trout were extirpated from the southernmost portion of their historic range, the McCloud River in California, around 1975 (Rode 1990, p. 32). Bull trout have been functionally extirpated (i.e., few individuals may occur there but do not constitute a viable population) in the Coeur d'Alene River basin in Idaho and in the Lake Chelan and Okanogan River basins in Washington (USFWS 1998, pp. 31651-31652).

These declines result from the combined effects of habitat degradation and fragmentation, the blockage of migratory corridors; poor water quality, angler harvest and poaching, entrainment (process by which aquatic organisms are pulled through a diversion or other device) into diversion channels and dams, and introduced nonnative species. Specific land and water management activities that depress bull trout populations and degrade habitat include the effects of dams and other diversion structures, forest management practices, livestock grazing, agriculture, agricultural diversions, road construction and maintenance, mining, and urban and rural development (Beschta et al. 1987, entire; Chamberlain et al. 1991, entire; Furniss et al. 1991, entire; Meehan 1991, entire; Nehlsen et al. 1991, entire; Sedell and Everest 1991, entire; Craig and Wissmar 1993pp, 18-19; Henjum et al. 1994, pp. 5-6; McIntosh et al. 1994, entire; Wissmar et al. 1994, entire; MBTSG 1995a, p. 1; MBTSG 1995b. pp. i-ii; MBTSG 1995c, pp. i-ii; MBTSG 1995d, p. 22; MBTSG 1995e, p. i; MBTSG 1996a, p. i-ii; MBTSG 1996b, p. i; MBTSG 1996c, p. i; MBTSG 1996d, p. i; MBTSG 1996e, p. i; MBTSG 1996f, p. 11; Light et al. 1996, pp. 6-7; USDA and USDI 1995, p. 2).

Emerging Threats

<u>*Climate Change*</u>

Climate change was not addressed as a known threat when bull trout was listed. The 2015 bull trout recovery plan and RUIPs summarize the threat of climate change and acknowledges that some extant bull trout Core Area habitats will likely change (and may be lost) over time due to anthropogenic climate change effects, and use of best available information will ensure future conservation efforts that offer the greatest long-term benefit to sustain bull trout and their required coldwater habitats (USFWS 2015, p. vii, and pp. 17-20, USFWS 2015a-f).

Global climate change and the related warming of global climate have been well documented (IPCC 2007, entire; ISAB 2007, entire; Combes 2003, entire). Evidence of global climate change/warming includes widespread increases in average air and ocean temperatures and accelerated melting of glaciers, and rising sea level. Given the increasing certainty that climate change is occurring and is accelerating (IPCC 2007, p. 253; Battin et al. 2007, p. 6720), we can no longer assume that climate conditions in the future will resemble those in the past.

Patterns consistent with changes in climate have already been observed in the range of many species and in a wide range of environmental trends (ISAB 2007, entire; Hari et al. 2006, entire; Rieman et al. 2007, entire). In the northern hemisphere, the duration of ice cover over lakes and rivers has decreased by almost 20 days since the mid-1800's (Magnuson et al. 2000, p. 1743). The range of many species has shifted poleward and elevationally upward. For cold-water associated salmonids in mountainous regions, where their upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in range, which in turn can lead to a population decline (Hari et al. 2006, entire).

In the Pacific Northwest, most models project warmer air temperatures and increases in winter precipitation and decreases in summer precipitation. Warmer temperatures will lead to more precipitation falling as rain rather than snow. As the seasonal amount of snow pack diminishes, the timing and volume of stream flow are likely to change and peak river flows are likely to increase in affected areas. Higher air temperatures are also likely to increase water temperatures (ISAB 2007, pp. 15-17). For example, stream gauge data from western Washington over the past 5 to 25 years indicate a marked increasing trend in water temperatures in most major rivers.

Climate change has the potential to profoundly alter the aquatic ecosystems upon which the bull trout depends via alterations in water yield, peak flows, and stream temperature, and an increase in the frequency and magnitude of catastrophic wildfires in adjacent terrestrial habitats (Bisson et al. 2003, pp 216-217).

All life stages of the bull trout rely on cold water. Increasing air temperatures are likely to impact the availability of suitable cold water habitat. For example, ground water temperature is generally correlated with mean annual air temperature, and has been shown to strongly influence the distribution of other chars. Ground water temperature is linked to bull trout selection of spawning sites and has been shown to influence the survival of embryos and early juvenile rearing of bull trout (Baxter 1997, p. 82). Increases in air temperature are likely to be reflected in increases in both surface and groundwater temperatures.

Climate change is likely to affect the frequency and magnitude of fires, especially in warmer drier areas such as are found on the eastside of the Cascade Mountains. Bisson et al. (2003, pp. 216-217) note that the forest that naturally occurred in a particular area may or may not be the forest that will be responding to the fire regimes of an altered climate. In several studies related to the effect of large fires on bull trout populations, bull trout appear to have adapted to past fire disturbances through mechanisms such as dispersal and plasticity. However, as stated earlier, the future may well be different than the past and extreme fire events may have a dramatic effect on bull trout and other aquatic species, especially in the context of continued habitat loss, simplification and fragmentation of aquatic systems, and the introduction and expansion of exotic species (Bisson et al. 2003, pp. 218-219).

Migratory bull trout can be found in lakes, large rivers and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-warming impacts to lakes will likely lead to longer periods of thermal stratification and coldwater fish such as adfluvial bull trout will be restricted to these bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the bottom layers and intensify competition for food (Shuter and Meisner 1992. p. 11).

Bull trout require very cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. However, impacts on hydrology associated with climate change are related to shifts in timing, magnitude and distribution of peak flows that are also likely to be most pronounced in these high elevation stream basins (Battin et al. 2007, p. 6720). The increased magnitude of winter peak flows in high elevation areas is likely to impact the location, timing, and success of spawning and incubation for the bull trout and Pacific salmon species. Although lower elevation river reaches are not expected to experience as severe an impact from alterations in stream hydrology, they are unlikely to provide suitably cold temperatures for bull trout spawning, incubation and juvenile rearing.

As climate change progresses and stream temperatures warm, thermal refugia will be critical to the persistence of many bull trout populations. Thermal refugia are important for providing bull trout with patches of suitable habitat during migration through or to make feeding forays into areas with greater than optimal temperatures.

There is still a great deal of uncertainty associated with predictions relative to the timing, location, and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007, p 7) although the scale of that variation may exceed that of States. For example, several studies indicate that climate change has the potential to impact ecosystems in nearly all streams throughout the State of Washington (ISAB 2007, p. 13; Battin et al. 2007, p. 6722; Rieman et al. 2007, pp. 1558-1561). In streams and rivers with temperatures approaching or at the upper limit of allowable water temperatures, there is little if any likelihood that bull trout will be able to adapt to or avoid the effects of climate change/warming. There is little doubt that climate change is and will be an important factor affecting bull trout distribution. As its distribution contracts, patch size decreases and connectivity is truncated, bull trout populations that may be currently connected may face increasing isolation, which could accelerate the rate of local extinction beyond that resulting from changes in stream temperature alone (Rieman et al. 2007, pp. 1559-1560). Due to variations in land form and geographic location across the range of the bull trout, it appears that some populations face higher risks than others. Bull trout in areas with currently degraded water temperatures and/or at the southern edge of its range may already be at risk of adverse impacts from current as well as future climate change.

The ability to assign the effects of gradual global climate change to bull trout or to a specific location on the ground is beyond our technical capabilities at this time.

Conservation

<u>Conservation Needs</u>

The 2015 recovery plan for bull trout established the primary strategy for recovery of bull trout in the coterminous United States: 1) conserve bull trout so that they are geographically widespread across representative habitats and demographically stable1 in six recovery units; 2) effectively manage and ameliorate the primary threats in each of six recovery units at the Core Area scale such that bull trout are not likely to become endangered in the foreseeable future; 3) build upon the numerous and ongoing conservation actions implemented on behalf of bull trout since their listing in 1999, and improve our understanding of how various threat factors potentially affect the species; 4) use that information to work cooperatively with our partners to design, fund, prioritize, and implement effective conservation actions in those areas that offer the greatest long-term benefit to sustain bull trout and where recovery can be achieved; and 5) apply adaptive management principles to implementing the bull trout recovery program to account for new information (USFWS 2015, p. v.).

Information presented in prior draft recovery plans published in 2002 and 2004 (USFWS 2002a, 2004) have served to identify recovery actions across the range of the species and to provide a framework for implementing numerous recovery actions by our partner agencies, local working groups, and others with an interest in bull trout conservation.

The 2015 recovery plan (USFWS 2015) integrates new information collected since the 1999 listing regarding bull trout life history, distribution, demographics, conservation successes, etc., and integrates and updates previous bull trout recovery planning efforts across the range of the single DPS listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

The Service has developed a recovery approach that: 1) focuses on the identification of and effective management of known and remaining threat factors to bull trout in each Core Area; 2) acknowledges that some extant bull trout Core Area habitats will likely change (and may be lost) over time; and 3) identifies and focuses recovery actions in those areas where success is likely to meet our goal of ensuring the certainty of conservation of genetic diversity, life history features, and broad geographical representation of remaining bull trout populations so that the protections of the Act are no longer necessary (USFWS 2015, p. 45-46).

To implement the recovery strategy, the 2015 recovery plan establishes categories of recovery actions for each of the six Recovery Units (USFWS 2015, p. 50-51):

1. Protect, restore, and maintain suitable habitat conditions for bull trout.
2. Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity.
3. Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

4. Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change.

Bull trout recovery is based on a geographical hierarchical approach. Bull trout are listed as a single DPS within the five-state area of the coterminous United States. The single DPS is subdivided into six biologically-based recover units: 1) Coastal Recovery Unit; 2) Klamath Recovery Unit; 3) Mid-Columbia Recovery Unit; 4) Upper Snake Recovery Unit; 5) Columbia Headwaters Recovery Unit; and 6) Saint Mary Recovery Unit (USFWS 2015, p. 23). A viable recovery unit should demonstrate that the three primary principles of biodiversity have been met: representation (conserving the genetic makeup of the species); resiliency (ensuring that each population is sufficiently large to withstand stochastic events); and redundancy (ensuring a sufficient number of populations to withstand catastrophic events) (USFWS 2015, p. 33).

Each of the six recovery units contain multiple bull trout Core Areas, 116 total, which are non-overlapping watershed-based polygons, and each Core Area includes one or more local populations. Currently there are 109 occupied Core Areas, which comprise 611 local populations (USFWS 2015, p. 3). There are also six Core Areas where bull trout historically occurred but are now extirpated, and one research needs area where bull trout were known to occur historically, but their current presence and use of the area are uncertain (USFWS 2015, p. 3). Core areas can be further described as complex or simple (USFWS 2015, p. 3-4). Complex Core Areas contain multiple local bull trout populations, are found in large watersheds, have multiple life history forms, and have migratory connectivity between spawning and rearing habitat and FMO habitats. Simple Core Areas are those that contain one bull trout local population. Simple Core Areas are small in scope, isolated from other Core Areas by natural barriers, and may contain unique genetic or life history adaptations.

A local population is a group of bull trout that spawn within a particular stream or portion of a stream system (USFWS 2015, p. 73). A local population is considered to be the smallest group of fish that is known to represent an interacting reproductive unit. For most waters where specific information is lacking, a local population may be represented by a single headwater tributary or complex of headwater tributaries. Gene flow may occur between local populations (e.g., those within a core population), but is assumed to be infrequent compared with that among individuals within a local population.

Recovery Units and Local Populations

The final recovery plan (USFWS 2015) designates six bull trout recovery units as described above. These units replace the 5 interim recovery units previously identified (USFWS 1999). The Service will address the conservation of these final recovery units in our section 7(a)(2) analysis for proposed Federal actions. The recovery plan (USFWS 2015), identified threats and factors affecting the bull trout within these units. A detailed description of recovery implementation for each recovery unit is provided in separate recovery unit implementation plans (RUIPs)(USFWS 2015a-f), which identify conservation actions and recommendations needed for each Core Area, forage/ migration/ overwinter areas, historical Core Areas, and research needs areas. Each of the following recovery units (below) is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

Coastal Recovery Unit

The coastal recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015a). The Coastal Recovery Unit is located within western Oregon and Washington. The Coastal Recovery Unit is divided into three regions: Puget Sound, Olympic Peninsula, and the Lower Columbia River Regions. This recovery unit contains 20 Core Areas comprising 84 local populations and a single potential local population in the historic Clackamas River Core Area where bull trout had been extirpated and were reintroduced in 2011, and identified four historically occupied Core Areas that could be re-established (USFWS 2015, pg. 47; USFWS 2015a, p. A-2). Core areas within Puget Sound and the Olympic Peninsula currently support the only anadromous local populations of bull trout. This recovery unit also contains ten shared FMO habitats which are outside Core Areas and allows for the continued natural population dynamics in which the Core Areas have evolved (USFWS 2015a, p. A-5). There are four Core Areas within the Coastal Recovery Unit that have been identified as current population strongholds: Lower Skagit, Upper Skagit, Quinault River, and Lower Deschutes River (USFWS 2015, p.79). These are the most stable and abundant bull trout populations in the recovery unit. The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, loss of functioning estuarine and nearshore marine habitats, development and related impacts (e.g., flood control, floodplain disconnection, bank armoring, channel straightening, loss of instream habitat complexity), agriculture (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation, livestock grazing), fish passage (e.g., dams, culverts, instream flows) residential development, urbanization, forest management practices (e.g., timber harvest and associated road building activities), connectivity impairment, mining, and the introduction of non-native species. Conservation measures or recovery actions implemented include relicensing of major hydropower facilities that have provided upstream and downstream fish passage or complete removal of dams, land acquisition to conserve bull trout habitat, floodplain restoration, culvert removal, riparian revegetation, levee setbacks, road removal, and projects to protect and restore important nearshore marine habitats.

Klamath Recovery Unit

The Klamath recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015b). The Klamath Recovery Unit is located in southern Oregon and northwestern California. The Klamath Recovery Unit is the most significantly imperiled recovery unit, having experienced considerable extirpation and geographic contraction of local populations and declining demographic condition, and natural re-colonization is constrained by dispersal barriers and presence of nonnative brook trout (USFWS 2015, p. 39). This recovery unit currently contains three Core Areas and eight local populations (USFWS 2015, p. 47; USFWS 2015b, p. B-1). Nine historic local populations of bull trout have become extirpated (USFWS 2015b, p. B-1). All three Core Areas have been isolated from other bull trout populations for the past 10,000 years (USFWS 2015b, p. B-3. The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, habitat degradation and fragmentation, past and present land use practices, agricultural water diversions, nonnative species, and past fisheries management practices. Conservation measures or recovery actions implemented include removal of nonnative fish (e.g., brook trout, brown trout, and hybrids), acquiring water rights for instream flows, replacing diversion structures, installing fish screens, constructing bypass channels, installing riparian fencing, culvert replacement, and habitat restoration.

Mid-Columbia Recovery Unit

The Mid-Columbia recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015c). The Mid-Columbia Recovery Unit is located within eastern Washington, eastern Oregon, and portions of central Idaho. The Mid-Columbia Recovery Unit is divided into four geographic regions: Lower Mid-Columbia, Upper Mid-Columbia, lower Snake, and Mid-Snake Geographic Regions. This recovery unit contains 24 occupied Core Areas comprising 142 local populations, two historically occupied Core Areas, one research needs area, and seven FMO habitats (USFWS 2015, pg. 47; USFWS 2015c, p. C-1–4). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, agricultural practices (e.g. irrigation, water withdrawals, livestock grazing), fish passage (e.g. dams, culverts), nonnative species, forest management practices, and mining. Conservation measures or recovery actions implemented include road removal, channel restoration, mine reclamation, improved grazing management, removal of fish barriers, and instream flow requirements.

Columbia Headwaters Recovery Unit

The Columbia headwaters recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015d, entire). The Columbia Headwaters Recovery Unit is located in western Montana, northern Idaho, and the northeastern corner of Washington. The Columbia Headwaters Recovery Unit is divided into five geographic regions: Upper Clark Fork, Lower Clark Fork, Flathead, Kootenai, and Coeur d'Alene Geographic Regions (USFWS 2015d, pp.

D-2 – D-4). This recovery unit contains 35 bull trout Core Areas; 15 of which are complex Core Areas as they represent larger interconnected habitats and 20 simple Core Areas as they are isolated headwater lakes with single local populations. The 20 simple Core Areas are each represented by a single local population, many of which may have persisted for thousands of years despite small populations and isolated existence (USFWS 2015d, p. D-1). Fish passage improvements within the recovery unit have reconnected some previously fragmented habitats (USFWS 2015d, p. D-1), while others remain fragmented. Unlike the other recovery units in Washington, Idaho and Oregon, the Columbia Headwaters Recovery Unit does not have any anadromous fish overlap. Therefore, bull trout within the Columbia Headwaters Recovery Unit do not benefit from the recovery actions for salmon (USFWS 2015d, p. D-41). The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, mostly historical mining and contamination by heavy metals, expanding populations of nonnative fish predators and competitors, modified instream flows, migratory barriers (e.g., dams), habitat fragmentation, forest practices (e.g., logging, roads), agriculture practices (e.g.

irrigation, livestock grazing), and residential development. Conservation measures or recovery actions implemented include habitat improvement, fish passage, and removal of nonnative species.

Upper Snake Recovery Unit

The Upper Snake recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015e, entire). The Upper Snake Recovery Unit is located in central Idaho, northern Nevada, and eastern Oregon. The Upper Snake Recovery Unit is divided into seven geographic regions: Salmon River, Boise River, Payette River, Little Lost River, Malheur River, Jarbidge River, and Weiser River. This recovery unit contains 22 Core Areas and 207 local populations (USFWS 2015, p. 47), with almost 60 percent being present in the Salmon River Region. The current condition of the bull trout in this recovery unit is attributed to the adverse effects of climate change, dams, mining, forest management practices, nonnative species, and agriculture (e.g., water diversions, grazing). Conservation measures or recovery actions implemented include instream habitat restoration, instream flow requirements, screening of irrigation diversions, and riparian restoration.

St. Mary Recovery Unit

The St. Mary recovery unit implementation plan describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the unit (USFWS 2015f). The Saint Mary Recovery Unit is located in Montana but is heavily linked to downstream resources in southern Alberta, Canada. Most of the Saskatchewan River watershed which the St. Mary flows into is located in Canada. The United States portion includes headwater spawning and rearing habitat and the upper reaches of FMO habitat. This recovery unit contains four Core Areas, and seven local populations (USFWS 2015f, p. F-1) in the U.S. Headwaters. The current condition of the bull trout in this recovery unit is attributed primarily to the outdated design and operations of the Saint Mary Diversion operated by the Bureau of Reclamation (e.g., entrainment, fish passage, instream flows), and, to a lesser extent habitat impacts from development and nonnative species.

Tribal Conservation Activities

Many Tribes throughout the range of the bull trout are participating on bull trout conservation working groups or recovery teams in their geographic areas of interest. Some tribes are also implementing projects which focus on bull trout or that address anadromous fish but benefit bull trout (e.g., habitat surveys, passage at dams and diversions, habitat improvement, and movement studies).

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APPENDIX B
STATUS OF DESIGNATED CRITICAL HABITAT: BULL TROUT

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Appendix B
Status of Designated Critical Habitat: Bull Trout

Past designations of critical habitat have used the terms "primary constituent elements" (PCEs), "physical and biological features" (PBFs) or "essential features" to characterize the key components of critical habitat that provide for the conservation of the listed species. The new critical habitat regulations (81 FR 7214) discontinue use of the terms "PCEs" or "essential features" and rely exclusively on use of the term PBFs for that purpose because that term is contained in the statute. To be consistent with that shift in terminology and in recognition that the terms PBFs, PCEs, and essential habit features are synonymous in meaning, we are only referring to PBFs herein. Therefore, if a past critical habitat designation defined essential habitat features or PCEs, they will be referred to as PBFs in this document. This does not change the approach outlined above for conducting the ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs or essential features.

Current Legal Status of the Critical Habitat

Current Designation

The U.S. Fish and Wildlife Service (Service) published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (USFWS 2010, entire); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on the Service's website: (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, which includes the Coastal, Klamath, Mid-Columbia, Upper Snake, Columbia Headwaters and St. Mary's Recovery Unit population segments. Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table 1. Stream/Shoreline Distance and Reservoir/Lake Area Designated as Bull Trout Critical Habitat.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir/ Lake Acres	Reservoir/ Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon[1]	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho[2]	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total[3]	19,729.0	31,750.8	488,251.7	197,589.2

[1] No shore line is included in Oregon
[2] Pine Creek Drainage which falls within Oregon
[3] Total of freshwater streams: 18,975

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

The final rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (USFWS 2010, p. 63903). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit

(CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

The Physical and Biological Features

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable Core Area populations (USFWS 2010, p. 63898). The Core Areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more Core Areas and may include FMO areas, outside of Core Areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the revised rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River Basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with physical and biological features (PBFs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support Core Areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; MBTSG 1998, pp. 48-49; Rieman and McIntyre 1993, pp. 22-23); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; MBTSG 1998, pp. 13-16; Rieman and Allendorf 2001, p. 763; Rieman and McIntyre 1993, p. 23).

Physical and Biological Features for Bull Trout

Within the designated critical habitat areas, the PBFs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the PBFs, as described within USFWS 2010, are essential for the conservation of bull trout. A summary of those PBFs follows.

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 abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, 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 °C to 15 °C, with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.
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 departure from a natural hydrograph.
8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PBF's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PBF to address the presence of nonnative predatory or competitive fish species. Although this PBF applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PBFs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PBFs 1 and 6. Additionally, all except PBF 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean low low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to "destroy or adversely modify" critical habitat by no longer serving the intended conservation role for the species or retaining those PBFs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PBFs to such an extent that the conservation value of critical habitat is appreciably reduced (USFWS 2010, pp. 63898:63943; USFWS 2004a, pp. 140-193; USFWS 2004b, pp. 69-114). The Service's evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998, Ch. 4 p. 39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (USFWS 2010, pp. 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (USFWS 2010, pp. 63898:63943).

Current Critical Habitat Condition Rangewide
The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (Ratliff and Howell 1992, entire; Schill 1992, p. 40; Thomas 1992, p. 28; Buchanan et al. 1997, p. vii; Rieman et al. 1997, pp. 15-16; Quigley and Arbelbide 1997, pp. 1176-1177). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (USFWS 1998, pp. 31648-31649; USFWS 1999, p. 17111).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PBFs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat
One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PBFs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Many of the PBFs for bull trout may be affected by the presence of toxics and/or increased water temperatures within the environment. The effects will vary greatly depending on a number of factors which include which toxic substance is present, the amount of temperature increase, the likelihood that critical habitat would be affected (probability), and the severity and intensity of any effects that might occur (magnitude).

The ability to assign the effects of gradual global climate change bull trout critical habitat or to a specific location on the ground is beyond our technical capabilities at this time.

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APPENDIX C
STATUS OF BULL TROUT IN CORE AREAS ASSOCIATED WITH THE ACTION AREA

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Appendix C
Status Of Bull Trout in Core Areas Associated with the Action Area

The Action Area is located within the Mid-Columbia Recovery Unit (MCRU), which includes portions of central Idaho, eastern Washington, and eastern Oregon (USFWS 2015a, b). The MCRU encompasses 24 Core Areas, two historically occupied areas, and one research needs area, and includes seven segments of shared FMO habitat. Shared FMO habitats are defined as relatively large streams and mainstem rivers, including lakes or reservoirs, estuaries, and nearshore environments, where subadult and adult migratory bull trout forage, migrate, mature, or overwinter (USFWS 2015b, p. C-2). The Action Area primarily overlaps the Snake River shared FMO habitat, but also overlaps the eastern extent of the Clearwater River shared FMO habitat. Any foraging, migrating, or over-wintering bull trout that occur within the Action Area represent adult or subadult bull trout that originate from, or potentially interact with, various Core Areas found within major tributaries of the mid-Columbia, Snake, and Clearwater Rivers. Bull trout movement between these three larger river systems is described in the following paragraphs.

The mainstem mid-Columbia River Basin portion of the MCRU encompasses areas of the mainstem Columbia River from John Day Dam, located approximately 76 miles downstream of McNary Dam, upstream to the Canadian Border. Multiple Core Areas contribute to bull trout occurrence in the mid-Columbia River portion of the MRCU, a few of which are believed to contribute bull trout to the Action Area. These Core Areas include the Walla Walla River Core Area (3 local populations), located downstream of the Snake River confluence, and the Wenatchee River (seven local populations) and Entiat River (two local populations) Core Areas, located upstream of the confluence. Bull trout from the Walla Walla River Core Area have been documented as far upstream as the Lower Monumental Dam on the lower Snake River. At least one bull trout from the Entiat River Core Area was documented moving between the Entiat and Yakima River, but an average of only five adult bull trout are observed in the upstream passage facilities at Priest Rapids and Wanapum dams annually, suggesting very few bull trout from the Wenatchee or Entiat Core Areas could be present in the Action Area. There is no documentation of bull trout from the Yakima River Core Area moving into the mainstem Columbia River (Barrows et al. 2016).

The lower Snake River basin of the MCRU includes the Snake River from its mouth at the confluence with the Columbia River upstream to the confluence of the Salmon River. Bull trout from the lower Snake River have been documented entering the Columbia River (Anglin et al. 2012, p. 3). Multiple Core Areas contribute bull trout to the lower Snake River, some of which may occur in the Action Area. These include the Tucannon River, Asotin Creek, Imnaha River, and potentially one or more of the four Core Areas of the Grande Ronde River basin. The Tucannon River enters the Snake River at the lower portion of Lower Monumental Reservoir, while the Asotin Creek, Imnaha, and the Grande Ronde Rivers enter the Snake River upstream of Lower Granite Dam. Bull trout from the Tucannon River Core Area, and to a much lesser degree, the Asotin Creek and Imnaha Core Areas, have been documented in the lower Snake River. There is no documentation of bull trout from the Grande Ronde River interacting with mainstem Snake River dams (Barrow et al. 2016); however, bull trout from the Grande Ronde have been documented entering the Snake River above the dams.

The Clearwater River Basin of the MCRU extends from the mouth near Lewiston, Idaho to the east across Idaho. The Clearwater River Basin supports four Core Areas of bull trout: South Fork Clearwater River, North Fork Clearwater River, Lochsa River, and the Selway River. There are no local populations of bull trout in the lower Clearwater River (USFWS 2015b, p. C-3), but the lower Clearwater River, part of the Clearwater River shared FMO habitat, provides essential FMO habitat and connectivity between Core Areas (USFWS 2015b, pp. C-3, C-321). PIT-tagged bull trout have been documented moving between the Clearwater River basin Core Areas and the lower Snake River.

Although bull trout have been documented making rather large migrations (Barrows et al. 2016, p. 177), long range migrants appear to make up a relatively small portion of their local population (Warnock et al. 2011 and Schaller et al. 2014, as cited in Barrows et al. 2016, p. 166). Long distance migrants tend to have greater reproductive capacity and contribute significantly to the viability of their source population (see Barrows et al. 2016, p. 197). Shared FMO habitats of the lower Snake and Clearwater Rivers are important for these individuals to meet their critical overwintering, spawning migration, and subadult and adult rearing needs. Thus, these areas support the viability of bull trout populations by contributing to successful rearing and overwintering survival and dispersal among Core Areas (USFWS 2015a, p. 35).

Status of Bull Trout in Core Areas that Influence the Action Area

Bull trout that occur in the Action Area are comprised of migratory adults and subadults that regularly move between the shared FMO habitat and Core Areas; thus, bull trout density in the Action Area and individual fitness are influenced by stressors and threats experienced in Core Areas in addition to those experienced within the shared FMO habitat. The following sections provide information on bull trout status and threats in those Core Areas that we have determined may contribute to bull trout presence in the Action Area; the Walla Walla River, Wenatchee River, Entiat River, Tucannon River, Asotin Creek, Imnaha River, one or more of the Core Areas of the Grande Ronde River, and one or more of the four Core Areas of the Clearwater River.

Where data is available, the status of a Core Area has been categorized as Depressed if the population size is small or historic, experiencing substantial threats, and/or has a long-term declining trend in population/redd counts; or as Stable if the Core Area has long-term stable, consistent or increasing population numbers or redd counts and/or has few threats impacting population persistence. Additionally, Core Area trend may be reported as Declining if population numbers or redd counts are reducing/declining in the last 7 years; Stable if there is no indication of population change in the last 7 to 10 years; or Increasing if population numbers or redd counts have been improving/increasing in recent years.

<u>Walla Walla River Core Area</u>

The Walla Walla River enters the Columbia River just downstream of the Snake River confluence at approximately RM 316. Major tributaries include the Touchet River (a separate Core Area that does not contribute bull trout to the Action Area), Mill Creek, and the South Fork of the Walla Walla River. The Walla Walla River Core Area contains three local populations in upper Mill Creek, Low Creek, and the South Fork Walla Walla River. While the South Fork

Walla Walla and Mill Creek currently support sizable populations of bull trout, including multiple life history expressions (Schaller et al. 2014), redd counts over the last 15 years have indicated notable declines in abundance (USFWS 2015b; Anglin et al. 2008a, b), from over 400 in 2001 to 100 in 2012. Populations in Mill Creek also declined as much as 63 percent between 2006 and 2010 (USFWS 2015b; Howell and Sankovich 2012, Howell et al. 2018). Several reports attribute declines in population to loss or reduced numbers of large migratory bull trout throughout the Basin (USFWS 2015b; Schaller et al. 2014; Barrows et al. 2016). The Service considers this Core Area depressed as a result of the declining trend in population and sizable threats.

Primary threats within the Walla Walla River Core Area include dewatering/low flows that result in seasonal barriers; water quality impairments from multiple sources (e.g., agricultural practices, urban development), elevated water temperatures, and structural passage barriers to migration (USFWS 2015b; 2008). Other threats include predation by smallmouth bass and walleye in FMO habitat, as well as competition by hatchery origin rainbow trout and brown trout. Incidental bycatch by anglers, hybridization and competition from brook trout, and forest management practices that increase the potential for catastrophic wildfire we recently recognized as primary threats (Gunkel and Allen 2021, p. 5). Entrainment at diversions and passage barriers, as well as temperature barriers and low flows, prevent bull trout from moving freely between spawning habitat and FMO habitat. Improving connectivity among local populations and between Core Areas throughout the Walla Walla River watershed and the mainstem Columbia River is critical to maintaining redundancy and supporting resiliency of bull trout in the Walla Walla River Core Area (USFWS 2015b; Schaller et al. 2014).

Bull trout migrations in the Walla Walla River Core Area are relatively well-documented (Barrows et al. 2016; Al-Chokhachy and Budy 2007, 2008; Al-Chokhachy et al. 2005, 2009; Budy et al. 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2012; Bowerman and Budy 2012; Bowerman 2013; Hemmingsen et al. 2001a, b, c, d, 2002). Sub-adults (> 200 millimeters [mm]) and small adults (< 350 mm) move downstream to the mainstem Walla Walla River or Columbia River in March and continue as surface flows decrease and water temperatures increase in June through August (Anglin et al. 2008b, 2009a, b, 2010; Barrows et al. 2012a, b; Schaller et al. 2014; Koch 2014). Emigration resumes in fall and continues through February (Barrows et al. 2016). Spawning adults return to the Walla Walla River and into upper tributaries between March through June and return to overwintering areas between September and February. Bull trout from the Walla Walla basin use the Columbia River during all times of the year.

There is limited data to determine the abundance of bull trout that enter the mainstem mid-Columbia River but may average approximately 100 individuals per year (Barrows et al. 2014, as cited in Barrows et al. 2016, pp 63 – 64). Although precise survival estimates for Walla Walla bull trout that enter the mainstem Columbia River are unknown, limited data suggests few bull trout that enter the mainstem return to the subbasin (Barrows et al. 2016). Only 54 percent of acoustic-tagged bull trout returned to the mouth of the Walla Walla, while only 18 percent of 89 PIT-tagged bull trout returned to the Walla Walla River (Barrows et al. 2016; Anglin et al. 2008b, 2009a, b, 2010; Barrows et al. 2012a, b). Of those 89 PIT-tagged bull trout, only one migrated to the Columbia River multiple times. Another PIT-tagged individual was recaptured within the Umatilla River Subbasin.

Mobile tracking data from acoustic-tagged bull trout indicated that bull trout were actively moving while occupying the mainstem Columbia River corridor (Barrows et al. 2016) and have been documented dispersing long distances (Anglin et al. 2010). Walla Walla subbasin bull trout have been documented upstream as far as Priest Rapids Dam on the Columbia River (Anglin et al. 2010) and at Lower Monumental dam on the lower Snake River. Bull trout moving to Lower Monumental dam must pass through Ice Harbor Dam; thus, we expect bull trout from the Walla Walla River Core Area occur in the Action Area, but the density is unknown. We expect greater occurrence near Ice Harbor Dam and that, given their documented propensity for continuous movement while in the mainstem river system, a few may occur near the Snake River/Clearwater River confluence. The proposed project will occur during the bull trout overwintering period. There is no information to determine whether any of these individuals overwinter in the Action Area, but it is possible if suitable habitat is available.

<u>Wenatchee River Core Area</u>

The Wenatchee Basin is located in Chelan County and drains into the Columbia River at RM 470 near the town of Wenatchee (NPCC 2004). There are seven local populations in tributaries of the Wenatchee River. Overall, the trend for the Wenatchee River Core Area seems to be stable and suggests a slightly increasing trend, although most of the stable trend is due to a single local population in the Chiwawa River. Across the Wenatchee River Core Area, threats to bull trout include habitat loss, historical land use practices including timber harvest, water withdrawals, fish management, and lost connectivity (USFWS 2015b). The Wenatchee River Core Area exhibits multiple life history patterns and is one of the most diverse populations in the MCRU (USFWS 2015b). Local populations consist of a migratory form that migrates from spawning areas near the crest of the Cascade Mountains to Lake Wenatchee, the mainstem Wenatchee, the Columbia River and back to other Core Areas to forage and overwinter. A small percentage (15 to 20 percent) is estimated to migrate long distances, including into other Core Areas, for foraging or overwintering and may migrate back to spawning areas annually, semi-annually, or every few years (USFWS 2006; Kelly Ringel et al. 2014; BioAnalysts 2004; Nelson and Nelle 2008; Stevenson et al. 2009). Overall, the trend for the Wenatchee River Core Area seems to be stable and suggests a slightly increasing trend, although most of the stable trend is due to a single local population in the Chiwawa River. Across the Wenatchee River Core Area, threats to bull trout include habitat loss, historical land use practices including timber harvest, water withdrawals, fish management, and lost connectivity (USFWS 2015b).

There have been no studies to determine the abundance of bull trout from the Wenatchee Core Area that enter the Columbia River and bull trout from this Core Area have not been documented in the lower Snake River. Bull trout would have to pass through a number of PUD-managed hydropower facilities to reach the lowest potion of the Action Area at Ice Harbor Dam. However, based on the status of the populations, migratory behavior, and the fact that bull trout appear to be able to navigate the PUD hydropower systems on the mainstem mid-Columbia River, it is possible some bull trout from the Wenatchee Core Area may migrate into the lower Snake River and may be present in the Ice Harbor portion of the Action Area. Given that the number of individuals that make long-distance migrations appears to decrease with distance, we expect any bull trout from the Wenatchee River Core Area will occur at very low densities, and we expect very few, if any, would migrate through the lower Snake River dams to reach the

Lower Granite Reservoir. There is no information to determine whether any Wenatchee River Core Area bull trout overwinter the Action Area, but it is possible if suitable habitat is available.

Entiat River Core Area

The Entiat River is located in Chelan County and enters the Columbia River near the town of Entiat, approximately 32 kilometers (km) (20 miles) upstream from Wenatchee at RM 484 of the Columbia River (USFS 2017). Due to the small size of the watershed, bull trout habitat and carrying capacity is limited in the Entiat River Core Area. Unique to the Entiat River Core Area, as much as 90 percent of the population uses the mainstem Columbia River for FMO (USFWS 2015b). The Entiat Core Area supports two local populations of bull trout: one in the upper mainstem Entiat River and one in the Mad River. Since 2000, the number of redds in the mainstem has fluctuated widely between 1 and 50 (Nelson 2014, p. 27). Within the Mad River, redd counts have varied from 7 to 52, continuing this trend through 2012 (USFS 2003, p. 1; Nelson 2014, p. 27). In 2008, the Entiat Core Area was listed as Stable, but at risk (USFWS 2008, p. 35) and has since been downgraded to Depressed (USFWS 2020, p. 184).

Legacy and ongoing land management actions have negatively affected bull trout habitat and have included timber harvest and fire suppression, irrigation diversions, grazing, and overfishing. The Entiat River is also subject to anchor ice scour in winter and flooding during spring and fall rainstorms, which combined with fire, irrigation, and grazing impacts has led to increased loss of habitat complexity. The low numbers of spawning migratory bull trout in the Entiat Core Area increases the risk of extirpation from stochastic events, and loss of connectivity between Core Areas in this region of the Columbia River (upstream of the Action Area) have impacted bull trout population resiliency. High variations in annual redd counts, high risk of extirpation from stochastic events, and reduced connectivity with other Core Areas classifies the Entiat River Core Area as depressed for this Opinion.

There are no studies to document the abundance of bull trout from the Entiat Core Area that move into the mid-Columbia River, but sub-adults move out of the Entiat in both the spring (peak in April – June) and fall (peaks in October - December). Returning spawners begin staging at the mouth of the Entiat River in May and June (Nelson 2014 p. i) and return to the Columbia River following the spawning period from September - December. Given their regular use of the mainstem Columbia River and the fact that bull trout from the Entiat Core Area have been documented making long-distance movement to the Yakima River (USFWS 2015b, p. C-6), it is possible some small number of bull trout may move into the lower Snake River and reach the Ice Harbor portion of the Action Area; there are no physical barriers between the mouth of the Yakima River and the Action Area. While bull trout from the Entiat River Core Area have not been documented in the Action Area, they have demonstrated long distance migrations and an ability to navigate the non-federal hydropower facilities of the Columbia River. Therefore, the presence of Entiat Core Area bull trout in the Action Area is possible, but we expect very low density based on the small size of the migratory population and distance to reach the Action Area. There is no information to determine whether any of these individuals may overwinter the Action Area, but it is possible if suitable habitat is available.

Tucannon River Core Area

The Tucannon River originates in the Wenaha-Tucannon Wilderness Area of the Blue Mountains in southeastern Washington and enters into the Snake River at RM 62, upstream of Lower Monumental Dam and downstream of Little Goose Dam (USFWS 2000). Genetic analyses indicate there are currently five local populations of bull trout, and possibly a sixth, within the Core Area of the Tucannon River watershed (USFWS 2008; Kassler and Mendel 2013). These local populations have been considered fairly isolated from local populations in other regional tributaries, such as the Walla Walla River, Clearwater River, and Asotin Creek (USFWS 2010a). Both resident and migratory forms of bull trout still occur in the Tucannon River watershed (Martin et al. 1992; WDFW 1997). Bull trout still occupy most of their historic range in the Tucannon River watershed and, prior to 2000, the population of the Core Area was considered relatively large (USFWS 2010b).

Between 2000 and 2007, annual redd counts and capture records suggest that populations in the Tucannon River underwent a noticeable decline, averaging from over 100 during the early 2000s to less than 20 by 2007 (Mendel et al. 2006; Bretz 2011), while the average number of migrating bull trout documented at the Tucannon Hatchery trap declined from over 250 to approximately 50. More recent information indicates the Tucannon River population may have rebounded somewhat, with over 230 bull trout observed during trapping and survey activities in 2013 (WDFW 2014, p. 7) and recent redd count data. However, it is still unclear if the populations have stabilized and the population is considered Depressed. The cause of declines is unknown, but many of the bull trout captured in 2007 were considered in poor health with new or recent injuries (cuts and scrapes), which could be attributed to two large fires occurred in the Tucannon River watershed during the mid-2000s that resulted in higher sediment delivery to streams in the Core Area (USFWS 2008) or may be attributed to a reduction in migratory fish due to fish age (older fish died after spawning) or because of seasonal migration barriers preventing returns (Bretz 2011, p. 19). Loss of nutrients and a declining prey base from dwindling anadromous salmonid populations, and physical (e.g., dams, fences, nets, weirs) or temperature barriers in the mainstem Tucannon River and its tributaries are also likely contributing factors (CCD 2004, p. 136).

The local populations of bull trout within the Tucannon River watershed can still generally move freely among their natal streams (Deeds 2008, p. 14). Several partial, seasonal or potential barriers exist throughout the Basin and dams on the Snake River hinder bull trout movement between Core Areas. The Tucannon Hatchery trap, located at RKM 58 (RM 36), is a partial barrier to bull trout movements during the trapping season from January to September (Bumgarner and Engle 2020). In addition, rock and debris dams on several Tucannon River tributaries have been known to block migration of bull trout in the watershed (Faler et al. 2008). Other ongoing threats include flood control, irrigation withdrawals, livestock grazing, logging, hydropower production, management of non-native fish species, recreation, urbanization, and transportation networks (USFWS 2008; Anchor 2011).

Recent data indicate that migratory bull trout from the Tucannon River use the mainstem Snake River (Underwood et al. 1995; WDFW 1997; Faler et al. 2008; Bretz 2011; D. Wills, pers. comm. 2014 cited in USFWS 2020). Migration to the mainstem typically occurs from October to June for both adults and subadults, and spawning migrations typically occur from March to July. Limited evidence from radio and PIT-tags found between 6 and 29 percent of bull trout captured in the Tucannon River entered the reservoir-influenced section of the lower Tucannon or the mainstem lower Snake River between 2002 and 2009 (Barrows et al. 2016, p. 84), but annual estimates of bull trout entering the lower Snake River are unknown. Although difficulties with tracking bull trout in the lower Snake River has hindered estimates of use and movement patterns, Tucannon Core Area bull trout have been documented at three of the four lower Snake River dams (including each of the furthest upstream and downstream dams), at least one bull trout from the Tucannon subbasin has been documented at McNary Dam on the Columbia River, and two bull trout have been documented travelling to the upper reaches of the Clearwater River basin, one each in the Lochsa and Selway Rivers. The Tucannon River enters the lower Snake River between the upper and lower portions of the Action Area; thus, we expect bull trout from the Tucannon Core Area may be present in both portions of the Action Area. There is no information to determine whether any of these individuals overwinter in the Action Area when project implementation will occur, but it is possible if suitable habitat is available.

Asotin Creek Core Area

Originating out of the Blue Mountains in southeastern Washington, Asotin Creek enters the Snake River near Clarkston, Washington at RKM 234 (RM 145), approximately 56 km (35 mi) upstream of Lower Granite Dam (Kuttel 2002, p. 14; Barrows et al. 2016). Within the Asotin Creek Core Area, there is one known local bull trout population in North Fork Asotin Creek, which includes Cougar Creek (Kassler and Mendel 2008; J. Trump, pers. comm. 2015, cited in USFWS 2020, p. 130). Abundance information and redd count data indicate that the population is very small and likely at critical levels (Martin et al. 1992; Underwood et al. 1995; Mendel et al. 2006; J. Trump, pers. comm. 2015, cited in USFWS 2020, p. 130; Barrows et al. 2016). Redd counts in North Fork Asotin and Cougar Creeks ranged from 10 to 13 in survey years 2005, 2006, and 2012 (J. Trump, pers. comm. 2015, cited in USFWS 2020, p. 130). Current data suggest that the population consists of both resident and migratory forms (Kassler and Mendel 2008; Mayer and Schuck 2004; Mayer et al. 2006; Crawford et al. 2011; Barrows et al. 2016). However, data also suggests that instream conditions may seasonally limit movement of migratory bull trout in the Basin (Barrows et al. 2016).

Legacy effects of livestock grazing, forest practices, transportation, and recreation negatively affect water quality, sedimentation, and channel complexity throughout the Core Area (Kuttel 2002). Extensive flood damage to the channel and riparian zone in the mid-1990s are still apparent in George Creek (Ullman and Barber 2009). Many of these effects in the tributaries are being addressed through watershed planning and implementation processes and other mechanisms (WDFW 2006; Ullman and Barber 2009; Middle Snake Watershed Planning Unit 2011; Ecology 2011). The quality of FMO in the Snake River as well as habitat in the headwaters are likely to be important to the persistence of bull trout in Asotin Creek.

While studies have shown movement of bull trout throughout the Asotin Creek Core Area (Barrows et al. 2016), low instream flows, intermittent flows with areas of subsurface flows, and a partial to full passage barrier at Headgate Dam (RM 9 [RKM 6]) negatively impact the persistence of migratory bull trout and reduce connectivity between tributaries within the Core

Area. Migration to the Snake River has been documented in both spring and fall for subadults, and in both October and May for adults (Barrows 2016, p. 173). Few bull trout from the Asotin Core Area have been documented in the Snake River in recent years due to few tagging or genetic studies within the Basin. In 2016, a single bull trout from North Fork Asotin was documented at the fish passage facilities at Lower Granite Dam (T. Marsh, pers. comm. 2017, cited in USFWS 2020, p. 131). Due to the small population size of bull trout in the Asotin Core Area, the total number of bull trout using the lower Snake River is expected to be very low and likely very limited in the Lower Granite Reservoir.

Grande Ronde and Imnaha River Core Areas

The Grande Ronde River originates from the Blue Mountains of northeast Oregon and southeast Washington, flowing generally northeast to join the Snake River at RM169, approximately 20 miles upstream of Asotin, Washington. Divided into three watershed areas, the Upper Grande Ronde, Lower Grande Ronde, and Wallowa, the Grande Ronde River subbasin supports four Core Areas with 17 local populations. Three of the Core Areas and at least seven of the local populations support migratory bull trout (Barrows et al. 2016, p. 96). Populations in the Little Minam and Wenaha River support some of the most abundant populations in the lower Snake River geographic region and are considered Stable, but the population in the Upper Grande Ronde River is considered Depressed (USFWS 2015b, p. C-7), threatened by livestock grazing, forest practices, and connectivity barriers caused by low flows and high water temperatures (USFWS 2015b, p. C-32). Use of the mainstem Snake River by migratory bull trout from the Grande Ronde River Core Areas has not been directly observed, however sampling near the mouth suggests it is likely. Limited research suggests (Starcevich et al. 2012) that most bull trout that spawn in Grande Ronde tributaries limited their overwintered to the mainstem Grande Ronde with high site fidelity, suggesting the number of bull trout that exit the Grande Ronde is low, and there is no documentation of interactions with mainstem Snake River dams (Barrow et al. 2016). However, given several populations express migratory life histories, the Service expects a small number of bull trout from Grande Ronde Core Areas may use the mainstem Snake River seasonally for foraging, migration, and overwintering purposes. It is unclear whether these individuals occur within the Action Area, but the presence of strong populations in the Core Area, connectedness, and long distance migratory behavior suggests use of the Action Area may be likely, most likely in the Lower Granite Reservoir and including the dredging operations near the Snake River and Clearwater River confluence.

The Imnaha River subbasin supports one Core Area with eight local populations (USFWS 2015b, p. C-33). The Core Area supports both resident and migratory bull trout and is considered one of the most stable populations in the MCRU, along with the Wenaha (tributary to the Grande Ronde), Wenatchee, and Clearwater River basins populations (USFWS 2015b, p. C-8). The Service identified no primary threats associated with this population (USFWS 2015b, p. C-33). Sub-adult bull trout move into the lower Snake River mostly in the fall (Barrows et al. 2016, p.103). Adult bull trout move into the lower Snake River shortly after spawning and continue into January (Barrows et al. 2016, p.103). Approximately 800 to 1200 adult bull trout return from the lower Snake River to the Imnaha River each year, but radiotelemetry indicates bull trout use the lower Snake River primarily between the Imnaha River upstream to Hells Canyon Dam (Barrows et al. 2016). Interactions with mainstem lower Snake River dams are largely unknown, and none have been detected at the PIT detection arrays on any of the four lower Snake River dams (Barrows et al. 2016). However, from 2006 to 2011, 12 bull trout were collected at the Little Goose Dam juvenile fish facility, and samples were taken for genetic analysis. One of those samples was determined to be from the Imnaha River, indicating at least some use of the Lower Granite reservoir. Thus, we expect a small number of bull trout from the Imnaha Core Aera may be present near the dredging operations at the Snake River and Clearwater River confluence as well as near the disposal site.

Clearwater River Core Areas

The Clearwater River Basin is located east of Lewiston, Idaho, and extends from the Snake River confluence at Lewiston on the west to headwaters in the Bitterroot Mountains along the Idaho-Montana border. The Action Area includes the lower Clearwater River from the confluence with the lower Snake River to approximately RM2 in Lewiston, Idaho. Historic records of bull trout use and abundance in the lower Clearwater River are lacking, presumably because bull trout were considered a nuisance species and because records were not actively maintained (CBBTTAT 1998a, cited in Ecovista et al. 2003, p. 322), but bull trout presence in the lower Clearwater River is thought to be minimal.

Spawning and rearing has not been documented in any tributary to the Lower and Middle Fork Clearwater River watersheds (USFWS 2015b, p. C-3; 2014, p. 4). In 1999, a few bull trout were documented in the Upper Potlatch River, but none were found in the middle or lower drainage nor were any found in subsequent studies (Cochnauer et al. 1996, p. 124; Cochnauer et al. 2002, p. 62). Continued surveys by the Idaho Department of Fish and Game (IDFG) in lower Clearwater River tributaries have failed to capture any bull trout (B. Bowersox, IDFG, pers. comm. 2021), and since operations began in 1989, no bull trout have been documented at the spring-run downstream anadromous smolt migrant trap, located in the lower Clearwater River upstream of the Action Area. In 2008, the service ranked bull trout in the Clearwater River as declining (USFWS 2008, p. 33).

North Fork Clearwater River Core Area

The North Fork Clearwater River Core Area comprises 12 local populations of bull trout and includes the North Fork Clearwater River and all tributaries upstream of Dworshak Dam, but Dworshak Dam isolates bull trout populations in the North Fork Clearwater River Core Area from the South Fork Clearwater, Lochsa, and Selway River Core Areas (USFWS 2002, p. 17; 2005). Based on redd counts as an indicator of the Core Area population trend for all streams in the North Fork Clearwater River Core Area, the population went through an increasing trend from about 2000-2010's (USFWS 2013; Meyer et al. 2014; Erhardt and Scarnecchia 2014, cited in USFWS 2015b), but then stabilized beginning in 2010 (Hand et al. 2018, p. 80). The most recent redd counts have been declining but further monitoring is needed to determine stability. Bull trout are widely distributed within the North Fork Clearwater River Core Area, with bull trout redds documented in at least 33 streams associated with the 12 stream complexes identified. Bull trout migrate out of the Dworshak reservoir to tributary streams starting late May to mid-June and return mid-October (Cochnauer et al. 2002, Schriever and Schiff 2003, p. 21; Schiff and Schriever 2004, p. 9).

Prior to the construction of Dworshak Dam, bull trout likely migrated into the mainstem Clearwater River to overwinter, and mixed with individuals from the Lochsa, Selway, and South Fork Clearwater River Core Areas (USFS 2001). Incidental entrainment over Dworshak Dam has been documented using direct and indirect methods (CBBTTAT 1998b; Hanson et al. 2006) and, though not a primary risk to recovery of bull trout, is considered a risk factor (USFWS 2015b). Telemetry studies found bull trout captured at the base of Dworshak Dam have remained within the lower Clearwater River well above the Action Area. Connectivity to the Action Area is available and, while this Opinion assumes bull trout from this Core Area may be present in the Action Area near the confluence with the Snake And Clearwater River confluence, the number of individuals is assumed very low.

South Fork Clearwater Core Area

The mainstem South Fork Clearwater River provides subadult and adult rearing habitat as well as FMO habitat, and the Core Area provides connectivity for local populations within and among other Core Areas of the Clearwater River basin. The lower reaches of large tributaries in the Core Area provide thermal refuge in summer months (USFWS 2015b, p. C-323). IDFG (Schriever et al. 2008, pp. 131-138) has conducted juvenile bull trout distribution studies in most tributaries and headwater streams of the Core Area, confirming that bull trout are widely distributed throughout the South Fork Clearwater River (USFS 2014, p. 33). Local populations are considered strong and currently use spawning and rearing habitat in five stream complexes (USFS 2014, p. 33; USFWS 2015b, pp. C-322). No primary threats were identified in the Recovery Plan for this Core Area (USFWS 2015b, p. C-30) but threats from legacy upland and riparian land management, instream impacts, and non-native fish were identified as factors influencing populations (USFWS 2015b, p. C-323). Forest practices, mining, roads, and grazing activities have altered stream segments by reducing large wood recruitment, pool formation, and off-channel areas, and by increasing sedimentation (USFWS 2015b, p. C-30, C-323). Bull trout from the South Fork Clearwater Core Area use the mainstem Clearwater River for FMO. Although bull trout form this Core Area have never been documented in the Action Area, connectivity is available and we assume bull trout from this Core Area may be present in the Action Area in small numbers, seasonally, as temperatures allow, but likely do not extend toIce Harbor Dam.

Selway River Core Area

The Selway River Core Area, located in Idaho and Clearwater counties in Idaho, occurs primarily (85 percent) in the Selway-Bitterroot and Frank Church-River of No Return Wilderness Areas (USFS 2001, p. 1-9). The Selway River provides FMO habitat for 10 local populations of bull trout in the Core Area and provides connectivity for populations in other Core Areas of the lower Snake River geographic region (USFWS 2008, 2015b). The Selway River Core Area supports a metapopulation of fluvial bull trout that are widely distributed in variable densities; resident local populations are present in some upper tributary reaches. No primary threats were identified for this Core Area (USFWS 2015b). Subadult and adult bull trout use the Selway River as FMO habitat (CBBTTAT 1998c). Bull trout occupancy has been verified by USFS stream surveys (USFS 2009) and individuals are likely to use all accessible areas of the Selway River Core Area. High water temperatures may preclude use in some reaches during low flow, hot summer months (USFWS 2008). Connectivity to the Action Area has been documented. A Tucannon River origin bull trout, PIT-tagged at Lower Granite Dam in June 2021 was later observed at a PIT tag array in the Selway River later that month (PTAGIS, 2022). Given the widespread distribution of bull trout in the Core Area and connectivity to the Action Area, we assume bull trout from the Selway Core Area may be present in the Action Area in small numbers, most likely in the Lower Granite Reservoir, which includes the dredging near the Snake and Clearwater River confluence and including the disposal site.

Lochsa River Core Area

The Lochsa River Core Area is located in Idaho County, Idaho and extends from the confluence of the Lochsa and Selway Rivers to the headwaters of Colt Killed and Crooked Fork Creeks, which converge to form the Lochsa River. Seventeen local populations of bull trout are currently known to use spawning and rearing habitat throughout the Lochsa River Core Area. In 2008, the Lochsa population was considered stable (USFWS 2008, p. 34), and no primary threats were identified (USFWS 2015b, p. C-20). Adults and subadults are suspected to use nearly all accessible areas of the Core Area for FMO and rearing (CBBTTAT 1998c, p. 23), and the lower reaches of multiple tributaries provide thermal refuge from high summer in-stream temperatures in the mainstem Lochsa River. The Lochsa River provides important FMO habitat for the local populations within the Core Area and connectivity to populations in other Core Areas of the Clearwater River Basin (USFWS 2015b). Connectivity to the Action Area was confirmed when an adult bull trout of Tucannon River origin, PIT tagged at Lower Granite Dam in May 2021, was later observed at PIT tag array in the Lochsa River in mid-June 2021 (PTAGIS, 2022). Given the stability of the Core Area and connectivity to the Action Area, we assume bull trout from the Lochsa Core Area may be present in the Action Area in small numbers, most likely in the Lower Granite Reservoir.

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