UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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September 20, 2024

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Chief, Regulatory Branch
Seattle District, U.S. Army Corps of Engineers
P.O. Box 3755
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Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Northwest Grain Growers Wallula Dredging Project, Walla Walla County, Washington

Dear Mr. Tillinger:

This letter responds to your May 1, 2024, request for initiation of consultation with the National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act (ESA) for the subject action. Your request, including information submitted subsequent to that request, qualified for our expedited review and analysis because it met our screening criteria and contained all required information on, and analysis of, your proposed action and its potential effects to listed species and designated critical habitat.

The U.S. Army Corps of Engineers (Corps) submitted a consultation initiation package, including a Biological Assessment (BA) prepared by Anderson Perry & Associates, Inc. (AP) for Northwest Grain Growers, to NMFS on May 1, 2024. The Corps and AP concluded the proposed action was likely to adversely affect Upper Columbia River (UCR) spring-run Chinook salmon (*Oncorhynchus tshawytscha*), UCR steelhead (*O. mykiss*), Middle Columbia River (MCR) steelhead (*O. mykiss*), Snake River (SR) sockeye salmon (*O. nerka*), Snake River Basin (SRB) steelhead (*O. mykiss*), SR fall-run Chinook salmon (*O. tshawytscha*), SR spring/summer Chinook salmon (*O. tshawytscha*), and their critical habitat. We reviewed the initiation package and sent an email to the Corps on May 30, 2024, requesting additional information on the dimensions of the barges and boats that will be used to implement the project, and their expected duration on site. The Corps provided all requested information on June 4, 2024, and NMFS initiated consultation on this date.

We reviewed the Corps consultation request and related initiation package. Where relevant, we have adopted the information and analyses you have provided and/or referenced but only after our independent, science-based evaluation confirmed they meet our regulatory and scientific standards. We adopt by reference the following sections of the BA (Corps 2024): Section 1.3, Action Area (p. 1-2); Section 3, Project Description (pp. 3-1 through 3-3); Section 4, Natural History and Species Occurrence (p. 4-1 through 4-9); Section 5, Baseline Conditions (pp. 5-1 through 5-6); Section 6, Conservation Measures (pp. 6-1 through 6-2); Section 7, Analysis of

Effect, (pp. 7-1 through 7-7); Section 8, Interrelated and Interdependent Effects (p. 8-1); Section 9, Cumulative Effects (p. 9-1); Section 10, Finding of Effect (pp. 10-1 through 10-3); and Section 11, Essential Fish Habitat Consultation (pp. 11-1 through 11-2).

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024 (89 FR 24268). We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the ESA (89 FR 24268; 84 FR 45015). We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this biological opinion and incidental take statement (ITS) would not have been any different under the 2019 regulations or pre-2019 regulations.

As described in Section 3 (Project Description) of the BA (Corps 2024), and additional submitted information, the Corps proposes to authorize Northwest Grain Growers to conduct routine, maintenance dredging of its barge slip located adjacent to its grain elevator along the Columbia River (River Mile 314.5) near Wallula, Washington. In summary, Northwest Grain Growers proposes to dredge approximately 8,830 cubic yards of sediment from a 5,000 square foot (0.11 acres) area at the bottom of the existing barge slip. Based on prior maintenance dredging in the action area, additional dredging of this 5,000 square foot area will likely be needed about every 7 years. For each dredging event, a contractor will dredge from a derrick barge (7,720 square feet) with a mounted crane and clamshell/cable arm bucket (8 to 20 cubic yards). Dredged material will be placed into a 10,660 square foot container barge with filtered exit ports at the corners on one day, and unloaded to haul trucks located behind a temporary spill apron the next day after it dewaters. The crane will be operated for 8 hours each day, and excavate approximately 1,500 cubic yards of material per day. Haul trucks will transport the dredge spoils along an existing haul road to the upland disposal area on Northwest Grain Growers property. An 838 square foot tug boat will be used to move the barges. Turbidity monitoring will be conducted during dredging from a 192 square foot boat. Dredging will occur within the Washington State Department of Fish and Wildlife approved in-water work window for this segment of the Columbia River, December 15–February 28. Dredging will take 7 to 10 days to complete. As described in Section 6 (Conservation Measures) of the BA, conservation measures and best management practices will be implemented to avoid or minimize impacts to ESA-listed species and their critical habitat. We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not.

BIOLOGICAL OPINION

We examined the status of each species that would be adversely affected by the proposed action to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. We also examined the condition of critical habitat throughout the designated area and discuss the function of the physical or biological features essential to the conservation of the species that create the conservation value of that habitat. Section 4 (Natural History and Species Occurrence) and Section 5 (Baseline Conditions) of the BA include descriptions of the species and critical habitat in the action area, which is adopted here. NMFS' status of the species

summaries for each of the seven salmon and steelhead species that may be affected by the proposed action are available on the NOAA Fisheries website at ESA Section 7 Consultations on the West Coast | NOAA Fisheries, and incorporated by reference. NMFS also incorporates by reference the following 2022 5-year reviews:

- 2022 5-Year Review: Summary & Evaluation of Middle Columbia River Steelhead
- 2022 5-Year Review: Summary & Evaluation of Snake River Basin Steelhead
- 2022 5-Year Review: Summary & Evaluation of Upper Columbia River Spring-run Chinook Salmon and Upper Columbia River Steelhead
- 2022 5-Year Review: Summary & Evaluation of Snake River Fall-Run Chinook Salmon
- 2022 5-Year Review: Summary & Evaluation of Snake River Spring/Summer Chinook Salmon
- 2022 5-Year Review: Summary & Evaluation of Snake River Sockeye Salmon

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). A description of the action area is included on page 1–2 in Section 1.3 of the BA (Corps 2024), which is adopted here. As described in the BA, the action area includes the dredge prism (5,000 square feet, 0.11 acres) out approximately 300 feet to the Columbia River at the mouth of the barge slip, defined as the limit of potential in-water turbidity impacts. The action area also includes the area of barge and boat movements associated with dredging.

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02). The environmental baseline, and species and habitat use, are described in Sections 5 and 4 of the BA (Corps 2024), respectively, which are adopted here. The action area is in an impounded section of the Columbia River. The dredge area is in a relatively confined area that is outside the main flow of the Columbia River and located adjacent to the grain elevator. Very little riparian vegetation is present and the adjacent shorelines are steep riprap banks. In addition to the information provided in the BA, the action area baseline includes altered habitats and flow regimes caused by Columbia River hydrosystem development, that creates more favorable habitat conditions for invasive, non-native species that may compete with or prey upon juvenile salmonids.

The Columbia River in the action area is designated critical habitat, and supports rearing and migration of fish from all populations of UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, and SR spring/summer Chinook salmon. For the MCR steelhead DPS, only a portion of the DPS will be affected by the action: all

populations of the Yakima River major population group (MPG) and only the Walla Walla population of the Umatilla/Walla Walla MPG. The action area provides physical and biological features (PBFs) of critical habitat for rearing and migration, though these persist in a largely degraded condition. The ability of critical habitat in the action area to support recovery of these seven species is primarily limited by impacts of hydropower development and operation.

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

An assessment of the effects of the proposed action is provided in Section 7 of the BA (Corps 2024), and adopted here (50 CFR 402.14(h)(3)). Within the action area, rearing of juvenile UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead occurs year round. Juvenile migration downstream can occur year round, with most occurring March through September. Adult migration of UCR spring-run Chinook salmon, SR sockeye salmon, SR fall-run Chinook salmon, and SR spring/summer Chinook salmon occurs March through November, and will be complete prior to dredging. Adult UCR steelhead, SRB steelhead, and MCR steelhead are present (migrating or over-wintering) in the action area year round, and migration peaks at McNary Dam mid-June through mid-November. Because the work window is December 15 to February 28 and avoids migration periods for most species, NMFS expects that few juvenile UCR spring-run Chinook salmon, UCR steelhead, SR sockeye, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead; and few adult UCR, SRB, and MCR steelhead, will be present in the action area during the project.

As described above, the Corps proposes to authorize routine maintenance dredging of the Northwest Grain Growers barge slip near Wallula, Washington. The temporary and long-term effects of this proposed action to ESA-listed salmon and steelhead species identified by the Corps and AP are:

1. Juveniles may be disturbed, injured, or killed through contact (or near-contact) with dredging equipment.

2. Turbidity plumes associated with dredging may cause behavioral changes, including causing some fish to move out of preferred locations downstream of the construction area. These effects are expected to be localized to within the barge slip, temporary, and of short duration (a few minutes).

3. The operation of vessels and barges has the potential to release toxic or harmful substances, kill or injure listed fish, or disrupt normal behavior.

4. Activity and dredging in the barge slip are likely to cause fish in the Columbia River to temporarily avoid the active work area. The area of avoidance will be restricted to the barge slip out to its mouth at the Columbia River.

Potential effects to PBFs of critical habitat identified by the Corps and AP include:

1. Fine sediment released during dredging activities may minimally increase silt in the streambed substrate downstream of the barge slip for a short duration.

2. A slightly increased risk to water quality, as dredging activities may temporarily increase the potential for turbidity, fuel spills, and other environmental contamination in the immediate area of the barge slip.

3. A temporary disturbance of riparian and in-stream habitat.

4. A long-term change in the substrate distribution of the barge slip associated with dredging and removal of accumulated sediment.

5. Juvenile forage may be negatively affected if reduced water quality affects prey species distribution and abundance.

NMFS has evaluated the effects section in the BA and additional submitted information, and after our independent, science-based evaluation, determined that the additional information provided below is needed to complete our analysis.

Effects to Species

Entrainment

Entrainment/impingement may occur if fish are trapped in the clamshell/cable arm bucket during dredging of in-water sediment. The potential for entrainment is largely dependent on the likelihood of fish occurring within the dredging area, the scope and scale of the dredging activity, and the life stage of the fish. In-water work will occur when few juvenile salmon and steelhead and few adult steelhead will potentially be present in the action area. The mechanical dredging itself is unlikely to entrain adult fish (Wenger et al. 2017). Lowering and movement of the bucket will likely disturb juveniles and cause most of them to flee the action area. However, some may remain in the action area and be entrained or impinged in the clamshell/cable arm bucket and then deposited in the material barge, resulting in injury and death. Because few juvenile salmon and steelhead will be in the action area during dredging, and most of these juveniles will flee the action area when dredging begins, we expect a very few juvenile UCR salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead will be injured and killed from entrainment/impingement in the clamshell/cable arm bucket and the material barge during each dredging event of up to 8,830 cubic yards of sediment from a 5,000 square foot (0.11 acres) area every 7 years.

Increased Sedimentation and Turbidity

Low to moderate levels of turbidity can provide cover from predation (Gregory and Levings 1998). However, increased fine sediment can be detrimental to juvenile salmon and steelhead in several ways including avoidance of the area, abandonment of cover, stress, and reduced growth rates (Newcombe and Jensen 1996). Turbidity from increased fine sediment may disrupt steelhead feeding and territorial behavior and may displace fish from preferred feeding and resting areas. It can also delay adult migration to spawning habitat. Direct mortality can occur at very high concentrations or extended exposure to suspended solids. The severity of effect of suspended sediment increases as a function of the sediment concentration and exposure time (Bash et al. 2001; Newcombe and Jensen 1996).

A Dredging and Disposal Quality Control Plan will be developed and implemented for this project. The plan includes turbidity monitoring, as described in Section 3.2 of the BA and adopted here, to ensure turbidity confinement and requirements are met. If turbidity exceeds requirements, a silt curtain will be erected at the mouth of the barge slip, and placed approximately 12 inches above the bed of the river to allow fish passage.

Alteration or disturbance of the bank and/or bank vegetation will be minimal and limited to the portion of the barge slip nearest the dredging activities. Therefore, we expect very little sediment will be released from the project site. However, we expect intermittent and localized resuspension of sediment for 10 days from dredging and associated barge and boat movements every 7 years during each dredging event to result in pulses of increased turbidity and suspended sediment concentration. We expect turbidity plumes and fine sediments to disperse and settle within 300 feet of turbidity generating activities and contained in the barge slip. Because the substrate in and around the work areas consists primarily of silt, small particles that tend to stay suspended longer, we expect the pulses of elevated suspended sediment to be large and last several minutes to a few hours. We also expect few adults and juveniles migrating, holding, or rearing within the boat slip will be disturbed by the increased turbidity and flee the area, which will increase the risk of predation to a very few juveniles (Berg and Northcote 1985). We do not expect avoidance of the turbidity plumes to delay migration of steelhead adults or affect spawning success. Adult steelhead are highly mobile and will be able to avoid temporary, minor pulse of turbidity in the mainstem Columbia River.

Chemical Contamination

Additional impairment of water quality may result from accidental releases of fuel, oil, and other contaminants that can injure or kill aquatic organisms. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons (PAHs), which can kill salmon at high levels of exposure, and can cause sublethal, adverse effects at lower concentrations (Meador et al. 2006). Therefore, spills that make their way into the Columbia River could harm fish. The operation of equipment will occur from barges, boats, and the shore. NMFS anticipates that only very small quantities (ounces) of PAHs are likely with each accidental release or spill. In addition, conservation measures will be implemented to prevent or contain any spill that may occur (e.g., staging and fueling equipment in a protected location, emergency spill response kit available onsite, equipment inspection and maintenance). These

should minimize the risk of a spill and opportunity for contaminants to enter the waterway and affect salmon and steelhead. If a spill does occur, we expect containment will occur quickly with emergency spill kits located on site, and conservation measures will minimize its dispersal, limiting exposure and related impacts of adult and juvenile salmon and steelhead. For these reasons, NMFS does not expect any fish to be injured or killed by exposure to accidental releases of fuel, oil, and other contaminants caused by this action.

Overwater and In-water Structures and Predation

Juvenile salmon and steelhead rely heavily on light perception to orient themselves in space, capture prey, avoid predators, shoal, and migrate along the shoreline to the ocean (Ono and Simenstad 2014). The reduction of ambient light (e.g., light attenuation and shading) is one of the primary mechanisms by which over-water (barges, moored vessels) and in-water structures (piers and pilings) adversely affect salmon and steelhead. Docks, floats, and stationary barges moored in shallow water can block light and provide a haven for predatory fish such as smallmouth bass and northern pikeminnow, which prey on juvenile salmonids in the Columbia River system (Fritts and Pearsons 2004; Tabor et al. 2004; Vigg et al. 1991; Zimmerman and Ward 1999). Reduced light levels can impair fitness and survival in juvenile salmonids by altering certain behaviors, such as migration, feeding success, and predator avoidance (Nightingale and Simenstad 2001; Rondorf et al. 2010). Darkly shaded areas can delay fish migration and drive juvenile salmon into deeper waters during daylight. This, in turn, increases the risk of predation by exposing young salmon to larger fish and diving birds. In general, predation on juvenile salmonids increases as light intensity decreases (Petersen and Gadomski 1994; Tabor et al. 1998). Similarly, the presence of in-water pilings also creates shading and low velocity areas preferred by predatory fish. Predatory fish such as smallmouth bass and northern pikeminnow select and use in-water and overwater structures (Pribyl et al. 2004; Celedonia et al. 2008), and juvenile salmonids account for high portions of northern pikeminnow diets (Poe et al. 1991; Zimmerman and Ward 1999; Harnish et. al 2014).

Due to the timing of in-water work and the lack of natural cover, we expect few juvenile salmon and steelhead in the action area during project construction. Approximately 19,410 square feet of temporary overwater structure (i.e., barges and boats) will be present for 10 days during the in-water work window and create shaded areas that may attract predators such as smallmouth bass and northern pikeminnow (Petersen et al. 1993). Mooring spuds used by the Derrick barge will also create shaded and low velocity areas that attract predatory fish. Further, reduced light caused by the barges, boats and mooring spuds; and the presence of temporary in-water structures (mooring spuds and clamshell/cable arm bucket), may inhibit or alter migration pathways of juvenile salmonids, including delays due to disorientation, and a change in migratory routes into deeper waters. The barges, boats, mooring spuds, and clamshell/cable arm bucket will be located in areas used by juvenile UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead for feeding, resting, and growth during rearing and downstream migration (Mains and Smith 1964; Dauble et al. 1989; Beeman and Maule 2006; Chapman 2007; Timko et al. 2011). Therefore, we expect temporary overwater structures (19,410 square feet) and in-water structures will cause behavior modifications of a very few juvenile UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer

Chinook salmon, and MCR steelhead including altered migration and avoidance, that will increase risk of predation by predatory fish for up to 10 days every 7 years during each dredging event. Few adult steelhead will be over-wintering or migrating upstream during the in-water work, and we do not expect overwater or in-water structures to prevent upstream migration because the structures will not be present in the main Columbia River channel, and because dredging will not occur at night when adults can continue their upstream migration.

We also expect juvenile salmon and steelhead to alter their behavior during dredging from the presence and movement of the clamshell/cable arm bucket. We expect movement of the clamshell/cable arm bucket will cause juvenile salmon and steelhead to flee the area of dredging, increasing their risk of predation. Dredging will occur 8 hours per day for up to 10 days during each dredging event. Therefore, we expect a very few juvenile UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead will alter their behavior for up to 8 hours per day for 10 days every 7 years during each dredging event from the presence and movement of the clamshell/cable arm bucket, increasing their risk of predation.

Effects to Critical Habitat

Water Quality

Water quality will be reduced within the project area for 10 days during each dredging event. The proposed action is expected to temporarily increase delivery of sediment to the waterway and suspend fine sediment during dredging, and associated barge and boat movements, thereby increasing turbidity in the water column. Because erosion control measures and conservation measures (Section 6 of the BA) will be installed and maintained during construction, very little sediment is expected to be released from the project site. Localized resuspension of sediment during in-water activities will result in small pulses of increased turbidity and suspended sediment concentration up to 300 feet from dredging, and barge and boat, activities. We expect the pulses of elevated suspended sediment to last a few minutes to a few hours. NMFS also expects minor leaks and spills of petroleum-based fluids (not more than ounces) from the use of heavy equipment that will be contained on site. Therefore, NMFS expects small, temporary, and intermittent, negative effects to the water quality PBF from increased turbidity and suspended sediment concentration, and minor leaks and spills from heavy equipment, for 10 days every 7 years during each dredging event.

Substrate

Dredging will occur across 5,000 square feet (0.11 acres) inside an existing barge slip adjacent to the Columbia River. Minor levels of sediment deposition will occur intermittently in the action area for 10 days during each dredging event as small turbidity plumes settle out within 300 feet of dredging and associated barge and boat movements. Therefore, NMFS expects a small, intermittent, and temporary, negative effect to the substrate PBF every 7 years from dredging up to 8,830 cubic yards in 5,000 square feet, and from resuspension and settling of suspended sediment up to 300 feet downstream of dredging and associated barge and boat movements.

Forage

The proposed action will negatively affect the short-term availability of benthic invertebrates by dredging, and by covering or temporarily displacing them by resuspension and settling of suspended sediment up to 300 feet downstream of dredging and barge and boat movements. Terrestrial macroinvertebrate inputs and invertebrate drift will continue to contribute to salmonid forage, and will also recolonize disturbed substrate once project dredging is complete. We expect recolonization to occur within a few days to a few months after project completion (Fowler 2004; Griffith and Andrews 1981; Yount and Nemi 1990). Given the small area of temporary impacts, and the supply of forage from terrestrial inputs and invertebrate drift, NMFS expects this project to have a small, short-term (few months) negative effect on the forage PBF every 7 years from dredging and resuspension and settling of suspended sediments.

Unobstructed/Safe Passage

As described in the Effects to Species section above, we expect the project to temporarily hinder migration, rearing, and feeding of juvenile salmon and steelhead due to presence of the heavy machinery use during dredging, and structure and shading created by the barges, boats, and mooring spuds. Therefore, NMFS expects small, temporary negative effects to the safe passage PBF for 10 days every 7 years during each dredging event.

Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. NMFS is not aware of any future non-Federal activities within the action area that could adversely affect UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook, MCR steelhead, or their critical habitat. Therefore, NMFS assumes that future State and private actions and land uses will continue within the action area at roughly their current rate.

Integration and Synthesis

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

Species

Adults and juveniles from all populations of UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, and SR spring/summer Chinook salmon; all populations of the Yakima River MPG of MCR steelhead; and the Walla Walla population of the Umatilla/Walla Walla MPG of MCR steelhead use the action area as a migration corridor. Juveniles of these populations also rear in the action area, and adult steelhead may over-winter in, and migrate through, the action area.

NMFS recently reaffirmed that UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead have not achieved viable status and are at a continuing risk of extinction. Major threats include, but are not limited to: climate change, regulation of the Columbia River, and impairment of tributary habitat. Upper Columbia River spring-run Chinook salmon and SR sockeye salmon are listed as endangered, and UCR steelhead, SR sockeye salmon, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead are listed as threatened under the ESA. All populations of UCR spring-run Chinook salmon, UCR steelhead, and SR sockeye remain at high risk. While some populations of the other four species are viable, most populations within theses ESUs and DPSs remain at moderate or high risk (Ford 2022).

Based on the species life stages and the activities described in the submitted BA and supplemental information, the proposed action is expected to result in harm, harassment, injury or death of a very few juvenile UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead from entrainment/impingement; increased turbidity; increased predation; and migration obstruction from over-water structure (barges and boats) and in-water structures (spuds and clamshell/cable arm bucket. These adverse effects would be to juveniles from all populations of UCR spring-run Chinook salmon; UCR steelhead; SR sockeye salmon; SR fall Chinook salmon; SR spring/summer Chinook salmon; SRB steelhead; and the Yakima River MPG of MCR steelhead, and the Walla Walla population of the Umatilla/Walla Walla MPG, of MCR steelhead.

We expect lowering and movement of the clamshell/cable arm bucket will cause adult steelhead and most salmon and steelhead juveniles to flee the action area during each dredging event. Fleeing the area will not affect migration or spawning success of adult steelhead. However, we expect a very few juveniles from all seven species will not flee the action area and will be injured and killed from entrainment/impingement in the clamshell/cable arm bucket and material barge during the 10 days of dredging up to 8,830 cubic yards of sediment in 5,000 square feet every 7 years.

Intermittent pulses of turbidity generated during dredging, and barge and boat movements, will cause short term (a few minutes to a few hours) behavioral changes, including fleeing and avoidance of turbidity plumes, to a few adult steelhead and juvenile UCR, SRB, and MCR steelhead, and few juvenile UCR spring-run Chinook, SR sockeye, SR fall-run Chinook, and SR spring/summer Chinook salmon, within 300 feet of the area of dredging and barge and boat movements, for approximately 10 days during each dredging event. We expect adult steelhead

and some juvenile salmon and steelhead will flee the areas of higher turbidity, which will increase the risk of predation to a very few juveniles. We do not expect avoiding temporary, intermittent turbidity plumes to affect migration or spawning success of adult steelhead.

We also expect temporary overwater structure (19,410 square feet of barges and boats), and temporary in-water structure (clamshell/cable arm bucket and mooring spuds) will cause behavior modifications of a very few juvenile UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead, including altered migration and avoidance, that may intermittently increase the risk of predation by predatory birds and fish for approximately 10 days every 7 years during each dredging event. Few adult steelhead will be over-wintering or migrating upstream during the in-water work, and we do not expect overwater or in-water structures to prevent upstream migration because the structures will not be present in the main Columbia River channel, and because dredging will not occur at night when adults can continue their upstream migration.

NMFS has determined that the loss of a very few juvenile salmon and steelhead spread out among all populations of UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon; all populations of the Yakima MPG and the Walla Walla population of MCR steelhead caused by the proposed action, is not substantial enough to appreciably alter the abundance, productivity, spatial structure, or diversity of any populations of these species. Therefore, it is NMFS' opinion that when the effects of the action and cumulative effects are added to the environmental baseline, and in light of the status of the species, the effects of the action will not cause reductions in reproduction, numbers, or distribution that would reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead.

Critical Habitat

Critical habitat in the action area is degraded due to the continued existence and operation of the Columbia River System dams and Lake Wallula reservoir, and the existing grain elevator and associated structures. The Columbia River hydrosystem alters the river environment and affects fish passage by increasing the cross-sectional area of the Columbia River, reducing water velocity and increasing exposure to both native and nonnative predators. In addition, the cumulative effects of State and private actions within the action area are anticipated to continue to have negative effects on ESA-listed salmonids. Climate change is likely to further impact designated critical habitat by increasing water temperatures and altering the hydrological regime.

The proposed action will temporarily reduce the function of critical habitat PBFs for water quality (turbidity and chemical contamination), substrate, forage, and unobstructed passage.

A small, negative effect to the water quality PBF will result from turbidity and leaks and spills of petroleum-based fluids during each dredging event. Small, intermittent, and localized increases in turbidity are expected to last a few minutes to a few hours each for approximately 10 days,

and extend up to 300 feet from turbidity generating activities (dredging, movements of barges and boats) every 7 years. NMFS also expects minor leaks and spills of petroleum-based fluids (not more than ounces) from heavy equipment will be contained on site due to the implementation of the proposed BMPs.

A small, negative effect to the forage and substrate PBFs will result from dredging and resuspension and settling of suspended sediment that will occur during each dredging event. The proposed action will have a short-term negative effect on benthic macroinvertebrates by dredging them in 5,000 square feet, and by covering or displacing them by settling of suspended sediment up to 300 feet from dredging and associated barge and boat movements, causing a temporary change to prey availability every 7 years. We expect benthic macroinvertebrates will start to recolonize the action area as soon as the 10-day project is complete, and benthic communities to be reestablished in a few months.

A small, negative effect to the unobstructed passage PBF will occur from dredging, approximately 19,410 square feet of temporary overwater structures, and temporary in-water structures (clamshell/cable arm bucket and mooring spuds) present for 10 days during dredging every 7 years.

Based on our analysis that considers the current status of PBFs, adverse effects from the proposed action will cause a temporary and localized decline in the quality and function of PBFs in the action area. Because of the small scale and extent of the effects to PBFs, we do not expect a reduction in the conservation value of critical habitat in the action area. As we scale up from the action area to the designation area of critical for each species, the proposed action is not expected to appreciably reduce the conservation value of the designated critical habitat as a whole.

Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook, and MCR steelhead, or destroy or adversely modify their designated critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by guidance as to "create

the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take of a very few juveniles from all populations of UCR spring-run Chinook salmon, SR sockeye salmon, SR fall-run Chinook salmon, and SR spring/summer Chinook salmon; and juveniles from all populations of UCR steelhead, SRB steelhead, and the Yakima MPG of MCR steelhead and the Walla Walla population of MCR steelhead is reasonably certain to occur as follows:

1) injury and death of a very few juvenile salmon and steelhead entrained/impinged in the clamshell/cable arm bucket and material barge;
2) short-term changes in behavior of few juveniles, and increased predation of a very few juveniles displaced by turbidity plumes; and
3) increased predation of a very few juveniles from changes to migration behavior caused by the presence of overwater and in-water structures.

Incidental Take from Entrainment/Impingement

NMFS anticipates the proposed action will result in injury and death to juvenile salmon and steelhead by entrainment/impingement in the clamshell/swing arm bucket and material dredge. We expect dredging to occur for no more than 10 days every 7 years, with no more than 8,830 cubic yards of material moved in 5,000 square feet (0.11 acres). It is not possible to determine the number of fish injured and killed by entrainment/impingement during each dredging event because of the wide range of responses that individual fish will have during dredging. Further, the numbers of juvenile fish present at any time is highly variable. Therefore, NMFS uses a surrogate for incidental take caused by entrainment/impingement. The surrogate is the amount and areal extent of material dredged. The surrogate is causally linked to the take pathways because the scale of the effect is related to the amount and area of material removed. Thus, the extent of take will be exceeded if more than 8,830 cubic yards of sediment from a 5,000 square foot (0.11 acres) area at the bottom of the existing barge slip is dredged every 7 years. While this surrogate is coextensive with the proposed action, it functions as an effective reinitiation trigger because the amount and extent of dredging can easily be monitored and the Corps is obligated to notify NMFS and stop all activities if the extent of take is exceeded.

Incidental Take from Turbidity and Increased Predation

NMFS anticipates the proposed action will result in harm to fish by increasing turbidity from dredging and barge and boat movements. Take in the form of harm caused by the temporary increases in turbidity will be manifested in altered behaviors including avoidance of the area,

abandonment of cover, and exposure to predators. We expect turbidity plumes to extend no further than 300 feet from dredging and associated barge and boat movements, and persist for a few minutes to a few hours. It is not possible to determine the number of fish killed by the turbidity plumes because of the range of responses that individual fish will have, and because the numbers of fish present at any time is highly variable. Therefore, NMFS uses a surrogate for incidental take caused by the turbidity. The surrogate is the areal extent of the turbidity plume. The surrogate is causally linked to the take pathways because the scale of the effect is related to the size of the turbidity plume. Thus, the extent of take will be exceeded if turbidity plumes extend further than 300 feet from dredging and associated barge and boat movements. While this surrogate is coextensive with the proposed action, it functions as an effective reinitiation trigger because turbidity plumes will be monitored and reported daily and the Corps is obligated to notify NMFS and stop all activities if the extent of take is exceeded.

Incidental Take from Predation from Presence of In-water and Overwater Structures

NMFS expects the proposed action will result in harm, harassment, injury and death to juvenile salmon and steelhead by increases in exposure to fish predators. We expect injury or death of juvenile salmon and steelhead from increased predators due to the increase in shade from temporary overwater structures (19,410 square feet), and from temporary in-water structures (clamshell/cable arm bucket and mooring spuds).

Due to the highly variable number of juveniles that will be present in the action area at any given time, and difficulties in the ability to observe predation rates, it is not possible to determine the number of juveniles injured or killed by the presence of overwater and in-water structures. Therefore, NMFS uses surrogates for incidental take caused by these structures. The surrogates are causally linked to the take pathways because, for in-water and over-water structures, the risk of predation increases with the amount and size of in-water and overwater structures and the duration the structure is in place. The risk of death increases with the size of the structures because larger structures are expected to provide habitat for and harbor more predators and to alter behavior. The risk of death increases with duration of the structure presence because the longer the structures are present and harboring predators and altering behavior, the more opportunity there is for interaction between juvenile salmon and steelhead and their predators.

Therefore, the best available indicators to measure the extent of incidental take caused by increased predation due to in-water and overwater structures are:

- The duration of dredging,
- The amount and duration of temporary overwater structures, and
- The duration of temporary in-water structures.

Therefore, the extent of take will be exceeded if:

- Dredging occurs for more than 10 days during any one dredging event,
- More than 19,410 square feet of temporary overwater structure (barges and boats) is present during any one dredging event,
- Barges and boats are present for more than 10 days during any one dredging event, and

- Mooring spuds and the clamshell/cable arm bucket are present for more than 10 days during any one dredging event.

While these surrogates are coextensive with the proposed action, it functions as an effective reinitiation trigger because dredging will be monitored daily and the Corps is obligated to notify NMFS and stop all activities if the extent of take is exceeded.

Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to UCR spring-run Chinook salmon, UCR steelhead, SR sockeye salmon, SRB steelhead, SR fall-run Chinook salmon, SR spring/summer Chinook salmon, and MCR steelhead, or destruction or adverse modification of their critical habitat.

Reasonable and Prudent Measures

"Reasonable and prudent measures" (RPM) refer to those actions the Director considers necessary or appropriate to minimize the impact of the incidental take on the species (50 CFR 402.02).

The Corps shall:

- Track, monitor, and report on the proposed action to ensure that the project is implemented as proposed, and the amount and extent of take is not exceeded.

NMFS believes that full application of conservation measures included as part of the proposed action, together with the use of the RPM and terms and conditions described below, are necessary and appropriate to minimize the likelihood of incidental take of listed species due to completion of the proposed action.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The Corps or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement the reasonable and prudent measure above:

    a. Track and monitor dredging activities to ensure that the conservation measures are meeting the objective of minimizing take.

b. Record area of dredging and amount of material removed daily.
c. Conduct turbidity monitoring as follows:
    i. Monitoring will be conducted daily, every 4 hours during daylight hours, while in-water work is conducted.
    ii. Observations shall occur daily before, during, and after commencement of in-water work and compared to observable sediment load upstream of the action area.
    iii. Measure or observe background turbidity levels at an undisturbed site approximately 100 feet upstream of the project area.
    iv. Measure or observe turbidity levels approximately 300 feet from the dredging area, or within any visible turbidity plume.
d. Submit a completion of project report to NMFS two months after project completion. The completion report shall include, at a minimum, the following:
    i. Starting and ending dates for work completed during each dredging event, with in-water work period specified.
    ii. Summary and details of turbidity monitoring.
    iii. Any daily observed sediment plume from the in-channel work area to 300 feet away during the in-water construction period.
    iv. A summary of pollution and erosion control inspection results, including results of implementing required conservation measures, and including a description of any erosion control failure, contaminant release, and efforts to correct such incidences.
    v. Number and species of fish observed injured or killed.
    vi. Sizes of barges and boats used for dredging and water quality monitoring.
    vii. Duration barges and boats are in the action area.
    viii. Size of area dredged.
    ix. Amount of material dredged and disposed of.
    x. Reference to NMFS consultation number WCRO-2024-00919
e. All reports will be sent to: crbo.consultationrequest.wcr@noaa.gov.
f. If the amount or extent of take is exceeded, stop project activities and notify NMFS immediately.

Reinitiation of Consultation

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the federal agency where discretionary federal involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

ESSENTIAL FISH HABITAT RESPONSE

Thank you also for your request for essential fish habitat (EFH) consultation. NMFS reviewed the proposed action for potential effects on EFH pursuant to section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA), implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. We have concluded that the action would adversely affect EFH designated for Pacific Coast Salmon (PFMC 2014).

MAGNUSON–STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the associated physical, chemical, and biological properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects may result from actions occurring within EFH or outside of it and may include direct, indirect, site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH (50 CFR 600.905(b)).

The proposed project occurs within EFH for Pacific Salmon (PFMC 2014). NMFS determined the proposed action would adversely affect EFH as follows:

1. Short-term decrease in water quality due to the elevation of turbidity in the area of dredging (5,000 square feet) and up to 300 feet away from dredging activities (dredging, barge and boat movements) during each dredging event.
2. Short-term (several months) negative effects on forage by crushing, covering, or displacing benthic macroinvertebrates during dredging an area of approximately 5,000 square feet (0.11 acres), and by settling of suspended sediment and turbidity plumes up to 300 feet from sediment disturbing activities. Sediment disturbing activities are expected to occur for 10 days every 7 years.
3. Temporary, negative effect on substrate by dredging and by settling of suspended sediment and turbidity plumes up to 300 feet from sediment disturbing activities. Sediment disturbing activities are expected to occur for 10 days every 7 years.

NMFS determined that measures included in the BA are sufficient to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH. Therefore, NMFS has no additional EFH conservation recommendations to provide at this time. This concludes the EFH consultation.

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600. 920(l)).

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The biological opinion will be available through NOAA Institutional Repository [https://repository.library.noaa.gov]. A complete record of this consultation is on file at NMFS' Columbia Basin Branch.

Please direct questions regarding this letter to Colleen Fagan, Columbia Basin Branch, at 541-962-8512 or colleen.fagan@noaa.gov.

Sincerely,

Nancy L Munn

Nancy L. Munn, Ph.D.
Acting Assistant Regional Administrator
Interior Columbia Basin Office

cc: Brad Johnson, U.S. Army Corps of Engineers
Sue Brady, Anderson Perry & Associates, Inc.

bcc: CHRON File (pdf)
Division- File copy

REFERENCES

Bash, J., C. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. University of Washington.

Beeman, J. W., and A. G. Maule. 2006. Migration depths of juvenile Chinook salmon and steelhead relative to total dissolved gas super saturation in a Columbia River reservoir. Transactions of the American Fisheries Society 135:584–594.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410–1417.

Celedonia, M. T., R. A. Tabor, S. Sanders, S. Damm, D. W. Lantz, T. M. Lee, Z. Li, J. M. Pratt, B. E. Price, and L. Seyda. 2008. Movement and habitat use of Chinook salmon smolts, Northern pikeminnow, and smallmouth bass near the SR 520 Bridge, 2007 acoustic tracking study. U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Office Fisheries Division, Lacey, Washington.

Chapman, D. W. 2007. Effects of docks in Wells Dam pool on subyearling summer/fall Chinook salmon. Douglas County Public Utility District.

Corps (U.S. Army Corps of Engineers). 2024. Biological Assessment for Northwest Grain Growers Wallula Dredging. Prepared by Anderson Perry & Associates. 80 pp.

Dauble, D., T. L. Page, and R. W. Hanf. 1989. Spatial distribution of juvenile salmonids in the Hanford Reach, Columbia River. Fishery Bulletin 87:775–790.

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

Fowler, R. T. 2004. The recovery of benthic invertebrate communities following dewatering in two braided rivers. Hydrobiologia 523:17–28.

Fritts, A. L., and T. N. Pearsons. 2004. Smallmouth bass predation on hatchery and wild salmonids in the Yakima River, Washington. Transactions of the American Fisheries Society 133:880–895.

Gregory, R. S., and C. D. Levings. 1998. Turbidity Reduces Predation on Migrating Juvenile Pacific salmon. Transactions of the American Fisheries Society 127:275–285.

Griffith, J. S., and D. A. Andrews. 1981. Effects of a Small Suction Dredge on Fishes and Aquatic Invertebrates in Idaho Streams. North American Journal of Fisheries Management 1:21–28.

Harnish, R. A., E. D. Green, K. A. Deters, K. D. Ham, Z. Deng, H. Li, B. Rayamajhi, K. W. Jung, and G. A. McMichael. 2014. Survival of Wild Hanford Reach and Priest Hatcheries Fall Chinook Salmon Juveniles in the Columbia River: Predation Implications. PNNL-23719. Battelle Pacific Northwest National Laboratory prepared for the Pacific Salmon Commission under U.S. Department of Energy contract #DE-AC05-76RL01830. Richland, Washington. October.

Mains, E. M., and J. M. Smith. 1964. The distribution, size, time and current preferences of seaward migrant Chinook salmon in the Columbia and Snake Rivers. Fisheries Research Papers, Washington Department of Fisheries 2(3):5-43.

Meador, J. P., F. C. Sommers, G. M. Ylitalo, and C. A. Sloan. 2006. Altered growth and related physiological responses in juvenile Chinook salmon (*Oncorhynchus tshawytscha*) from dietary exposure to polycyclic aromatic hydrocarbons (PAH). Canadian Journal of Fisheries and Aquatic Sciences 63:2364–2376.

Newcombe, C. P., and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16:693–727.

Nightingale, B., and C. Simenstad. 2001. Overwater structures: marine issues, Washington State Department of Fish and Wildlife: p. 133.

NMFS (National Marine Fisheries Service). 2022. 2022 5-year Review: Summary and Evaluation of Middle Columbia River Steelhead. July 26, 2022. 87 pp.

NMFS. 2022. 2022 5-Year Review: Summary & Evaluation of Snake River Basin Steelhead. July 26, 2022. 95 pp.

NMFS. 2022. 2022 5-Year Review: Summary & Evaluation of Snake River Fall-Run Chinook Salmon. July 26, 2022. 87 pp.

NMFS. 2022. 2022 5-Year Review: Summary & Evaluation of Snake River Sockeye Salmon. July 26, 2022. 93 pp.

NMFS. 2022. 2022 5-Year Review: Summary & Evaluation of Snake River Spring/Summer Chinook Salmon. 101 pp.

NMFS. 2022. 2022 5-year Review: Summary and Evaluation of Upper Columbia River Spring-run Chinook Salmon and Upper Columbia River Steelhead. 95 pp.

Ono, K, and C. Simenstad. 2014. Reducing the effect of overwater structures on migrating juvenile salmon; an experiment with light. Journal of Ecological Engineering 71:180-189.

PFMC (Pacific Fishery Management Council). 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18 to the Pacific Coast Salmon

Plan: Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon. Pacific Fishery Management Council, Portland, Oregon. September 2014. 196 p. + appendices.

Petersen, J. H., and D. M. Gadomski. 1994. Light-mediated predation by northern squawfish on juvenile Chinook salmon. National Biological Survey, Pacific Northwest Natural Science Center, Columbia Research laboratory. Journal of Fish Biology 45: 227–242.

Petersen, J. H, S. T. Sauter, C. N. Frost, S. R. Gray, and T. P. Poe. 1993. Indexing juvenile salmonid consumption by northern squawfish in the Columbia River below Bonneville Dam and in John Day Reservoir, 1992. *In* J. H. Petersen and T. P. Poe (editors). Systemwide Significance of Predation on Juvenile Salmonids in Columbia and Snake River Reservoirs: Annual Report 1992 to Bonneville Power Administration, Portland, Oregon.

Poe, T. P., H. C. Hansel, S. Vigg, D. E. Palmer, and L. A. Predergast. 1991. Feeding of predaceous fishes on out-migrating juvenile salmonids in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:405–420.

Pribyl, A. L., J. S. Vile, and T. A. Friesen. 2004. Population structure, movement, habitat use, and diet of resident piscivorous fishes in the Lower Willamette River, Oregon Department of Fish and Wildlife: 139–184.

Rondorf, D. W., G. L. Rutz, and J. C. Charrier. 2010. Minimizing effects of over-water docks on federally listed fish stocks in McNary Reservoir: a literature review for criteria. Cook, Washington, U.S. Geological Survey, Western Fisheries Research Center: 41.

Tabor, R. A., G. Brown, and V. T. Luiting. 1998. The effect of light intensity on predation of sockeye salmon fry by prickly sculpin and torrent sculpin. U.S. Fish and Wildlife Service, Western Washington Office, Aquatic Resources Division, Lacey, Washington.

Tabor, R. A., M. T. Celedonia, F. Mejia, R. M. Piaskowski, D. L. Low, B. Footen, and L. Park. 2004. Predation of juvenile Chinook salmon by predatory fishes in three areas of the Lake Washington Basin. U.S. Fish and Wildlife Service, Lacey, Washington.

Timko, M. A., L. S. Sullivan, R. R. O'Connor, C. D. Wright, S. E. Rizor, J. L. Hannity, C. A. Fitzgerald, M. L. Meagher, J. D. Stephenson, J. R. Skalski, and R. L. Townsend. 2011. Behavior and survival analysis of juvenile steelhead and sockeye salmon through the Priest Rapids Hydroelectric Project in 2010, Public Utility District No. 2 of Grant County.

Vigg, S., T. P. Poe, L. A. Prendergast, and H. C. Hansel. 1991. Rates of consumption of juvenile salmonids and alternative prey fish by northern squawfish, walleyes, smallmouth bass, and channel catfish in John Day Reservoir, Columbia River. Transactions of the American Fisheries Society 120:421–438.

Wenger, A. S., E. Harvey, S. Wilson, C. Rawson, S. J. Newman, D. Clarke, B. J. Saunders, N. Browne, M. J. Travers, J. L. Mcilwain, P. L. A. Erftemeijer, J. P. A. Hobbs, D. Mclean, M. Depczynski, R. D. Evans. 2017. A critical analysis of the direct effects of dredging on fish. Fish and Fisheries 18, no. 5 (2017): 967–985.

Yount, J. D., and G. J. Niemi. 1990. Recovery of lotic communities and ecosystems from disturbance—a narrative review of case studies. Environmental Management 14(5):547–569.

Zimmerman, M. P., and D. L. Ward. 1999. Index of predation on juvenile salmonids by northern pikeminnow in the Lower Columbia River Basin, 1994–1996. Transactions of the American Fisheries Society 128:995–1007.