**UNITED STATES DEPARTMENT OF COMMERCE**
**National Oceanic and Atmospheric Administration**
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
7600 Sand Point Way N.E.
Seattle, Washington 98115

**F/NWR/2013/10095** October 3, 2014

Evan R. Lewis, Chief
U.S. Army Corps of Engineers, Seattle District
Environmental and Cultural Resources Branch
P.O. Box 3755
Seattle, WA 98124-3755

Subject: Mud Mountain Biological Opinion and Conference Opinion

Dear Mr. Lewis:

This letter conveys National Marine Fisheries Service's (NMFS) biological opinion, conference opinion, and Magnuson Stevens Fishery Conservation and Management Act consultation on your proposed action for the continued operation and maintenance of the Mud Mountain Dam project, near Buckley, Washington and associated activities. Our analysis is based on information provided in the Corps' April 2013 biological assessment for this project and other information pertinent to the affected species, and was conducted in conformance with Section 7(a)(2) of the Endangered Species Act (16 U.S.C. 1531 et seq.).

NMFS' biological opinion concludes that your proposed action would jeopardize the continued existence of Puget Sound Chinook salmon, Puget Sound steelhead, and Southern Resident killer whales and would adversely modify or destroy their designated and proposed critical habitats. Because we found jeopardy and adverse modification of critical habitat, we provided a reasonable and prudent alternative (RPA) that modifies your proposed action so that it would not jeopardize the continued existence of listed species or destroy or adversely their critical habitat. The RPA presents a schedule of improvements, designed to reduce losses of ESA-listed salmon and steelhead at the project.

Please provide NMFS with a letter indicating the Corps' final decision on the action and intent to fully implement the RPA within the timeframes identified in the RPA (50 CFR 402.15(b)).

Please contact Keith Kirkendall (503-230-5431) or Kim Kratz (503-231-2155) with any questions or concerns you may have.

Sincerely,

William W. Stelle, Jr.
Regional Administrator
NMFS West Coast Region

Enclosure

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

Mud Mountain Dam, Operations, and Maintenance
White River, HUC 17110014 Pierce and King Counties, Washington

**NMFS Consultation Number:** NWR-2013-10095

**Action Agency:** U.S. Army Corps of Engineers

**Affected Species and Determinations:**

| ESA-Listed Species | Status | Is Action Likely to Adversely Affect Species or Critical Habitat? | Is Action Likely To Jeopardize the Species? | Is Action Likely to Destroy or Adversely Modify Critical Habitat |
|---|---|---|---|---|
| Puget Sound Chinook salmon (Oncorhynchus Tshawytscha) | Threatened | Yes | Yes | Yes |
| Puget Sound steelhead (Oncorhynchus mykiss) | Threatened | Yes | Yes | Yes (proposed) |
| Southern Resident killer whale (Orcinus orca) | Endangered | Yes | Yes | Yes |

| Fishery Management Plan That Includes Stocks With EFH | Does Action Cause Adverse Effects to EFH? | Are EFH Conservation Recommendations Provided? |
|---|---|---|
| Pacific Coast Groundfish | No | No |
| Coastal Pelagic Species | No | No |
| Pacific Coast Salmon | Yes | Yes |

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

**Issued By:**

William W. Stelle, Jr.
Regional Administrator

**Date:** October 3, 2014

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ADP | Adaptive Management Plan |
| BA | Biological Assessment |
| BMI | Benthic Macroinvertebrates |
| BRT | Biological Review Team |
| BMP | Best Management Practice |
| Corps | US Army Corps of Engineers |
| CWA | Cascade Water Alliance |
| DBH | Diameter at breast height |
| DIP | Demographically Independent Population |
| DOE | Department of Ecology |
| DPS | Distinct Population Segment |
| DQA | Data Quality Act |
| EFH | Essential Fish Habitat |
| ESA | Endangered Species Act |
| ESU | Evolutionarily Significant Unit |
| HMP | Harvest Management Plan |
| HSRG | Hatchery Scientific Review Group |
| HUC | Hydrologic Unit Code |
| ITS | Incidental Take Statement |
| LWD | Large Woody Debris |
| MIT | Muckleshoot Indian Tribe |
| MMD | Mud Mountain Dam |
| MPG | Major Population Group |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| MSY | Maximum Sustainable Yield |
| NOR | Natural Origin Recruits |
| NMFS | National Marine Fisheries Service |
| Opinion | Biological Opinion |
| PCE | Primary Constituent Element |
| PFMC | Pacific Fishery Management Council |
| PIT | Passive Integrated Transponder |
| PS | Puget Sound |
| PSE | Puget Sound Energy |
| PSTRT | Pacific Sound Technical Recovery Team |
| PTI | Puyallup Tribe of Indians |
| RM | River Mile |
| RPA | Reasonable and Prudent Alternative |



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| | |
|---|---|
| RPM | Reasonable and Prudent Measures |
| SR killer whale | Southern Resident Killer Whale |
| SSPS | Shared Strategy for Puget Sound |
| TRT | Technical Recovery Team |
| TMDL | Total Maximum Daily Load |
| USACE | United States Army Corps of Engineers |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geologic Survey |
| WDFW | Washington Department of Fish and Wildlife |
| WDOE | Washington Department of Ecology |
| VSP | Viable Salmonid Population |
| WRIA | Water Resource Inventory Area |
| WWTIT | Western Washington Treaty Indian Tribes |

# 1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

## 1.1 Background

The biological opinion (Opinion) and incidental take statement (ITS) portions of this document were prepared by National Marine Fisheries Service ( NMFS) in accordance with the Endangered Species Act (ESA) of 1973, (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402. Included in this Opinion is an analysis of the proposed action's likely effects on recently proposed critical habitat for Puget Sound steelhead. This portion of the Opinion is termed a "Conference Opinion" and follows the process defined in 50 CFR 402.10.

NMFS also completed an Essential Fish Habitat (EFH) consultation in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 1855(b)) and implementing regulations at 50 CFR 600.

This Opinion and EFH conservation recommendations are both in compliance with section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-5444) ("Data Quality Act" (DQA)) and underwent pre-dissemination review.

## 1.2 Consultation History

This Opinion is the result of the U.S. Army Corps of Engineers' (Corps) reinitiating consultation on its Mud Mountain Dam (MMD) Project; and includes all aspects of project operation and maintenance, operation and maintenance of the White River diversion dam, replacement of the White River diversion dam, and Corps' operation and maintenance of the fish trap near Buckley, Washington, as described in the Corps' biological assessment (BA) (Corps 2013a).

In its initial consultation with NMFS on the MMD project in 2007, the Corps included a new fishway, along with replacing the existing White River diversion dam in its proposed action. NMFS relied on the Corps' commitment to construct and operate a new fishway by 2012, along with the other aspects of the 2007 proposed action in our analysis, and concluded that the proposed action would not jeopardize the continued existence of any affected species under NMFS jurisdiction, or destroy or adversely modify their critical habitats (NMFS 2007a). As of June 2013, the Corps had not completed design and construction of the new fish barrier structure and fishway.

NMFS sent the Corps a letter dated June 28, 2012, highlighting areas in which the Corps was out of compliance with the 2007 Opinion, including the ITS (NMFS 2012a). NMFS met with the Corps prior to re-initiation, on October 9, December 10, 2012, and February 13, 2013. NMFS held government-to-government meetings with the Muckleshoot Indian Tribe on June 20, 2013, and December 13 and 20, 2013.

The Corps requested to reinitiate consultation by sending NMFS a letter electronically via email on April 23, 2013 (Corps 2013b). NMFS sent a letter to the Corps, dated May 17, 2013,



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indicating that consultation could begin as soon as we received the 2012 smolt passage study report. [1] NMFS received the 2012 smolt passage raw data (Corps 2013c) and accepted the BA as complete on May 29, 2013. NMFS shared its draft biological opinion and reasonable and prudent alternative (RPA) with the Corps on October 31, 2013, and both agencies worked closely together to address the Corps' comments.

This Opinion is based on information provided in NMFS' 2007 biological opinion (NMFS 2007a), the Corps' new BA (Corps 2013a), field investigations, and other sources of information listed in the references cited section of the opinion. A complete record of this consultation is on file at NMFS' West Coast Region Office in Portland, Oregon.

### 1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Interrelated actions are those that are part of a larger action and depend on that action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

Mud Mountain Dam is a rock and earthfill dam constructed in 1948 for the sole purpose of controlling downstream floods. The upstream reservoir is normally dry and stores water only temporarily during active flood control operations, and as needed to facilitate maintenance activities at MMD and the downstream White River diversion dam. Water is passed through the dam via either 9-foot wide horseshoe-shaped tunnel at channel level (invert elevation 895 msl), or the 23-foot diameter pipe located 15 feet above the river channel (invert elevation 910 msl), useable only when the dam is impounding water. Downstream migrating fish also pass through one of these two tunnels. The dam has an emergency spillway, but it has never been used in the history of the project.

The project includes a trap-and-haul fishway constructed along-side Cascade Water Alliance's White River diversion dam 5.5 miles downstream from MMD (Figure 1). White River diversion dam serves as a barrier to upstream fish passage, and is intended to divert anadromous fish into a fish trap on one side of the river and collection facility for a tribal hatchery on the other.

[1] Smolts are juvenile salmon and steelhead that undergo certain morphological and physiological changes to facilitate their seaward migration and life in marine water.



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**Figure 1 Aerial view depicting White River diversion dam (barrier), the Corps' fish trap, and the Muckleshoot Indian Tribe's White River hatchery**

Operation and maintenance of the White River diversion dam, until it is replaced, is part of the proposed action and is covered by an agreement between Cascade Water Alliance (CWA), the dam's owner and the Corps. The diversion dam is an integral component of the trap and haul facility, serving as a barrier to further upstream migration by adult Chinook salmon and steelhead such that they must ascend the project fishway and enter the trap and haul facility. There is no upstream fishway at MMD itself and the only route of passage to fish habitats upstream of MMD is by way of the trap and haul system at the White River diversion dam. Historically, the diversion dam diverted up to 2,000 cfs to Puget Sound Energy's White River Hydroelectric Project, which has been decommissioned. It now diverts an average of 75 cfs from the river to maintain Lake Tapps and to serve as a municipal water supply. Following replacement with a new fish barrier structure, the new fish barrier would become a part of the MMD project.

The Corps proposes to continue to operate and maintain the Mud Mountain Dam Project on the White River in Pierce and King Counties, Washington for the next 30 years in the manner it is currently operated and maintained; and to replace, operate and maintain the White River diversion dam downstream from the project. The specific activities that make up the proposed action include:

- normal tunnel operations,
- impoundments for flood risk management and flow management,
- large wood management,
- fish trap operations,
- White River diversion dam repairs required for fish trap operation,
- tunnel repairs,
- woody debris management,
- repairs, and routine maintenance activities, and
- design and construction of a replacement fish passage barrier at the location of the existing White River diversion dam.

Details of the proposed action are presented in the BA (Corps 2013a), as clarified by the letter of November 1, 2013, from Evan Lewis, Corps, to Kim Kratz, NMFS, and we incorporate that description and clarification here by reference, and briefly recount that description below.

### 1.3.1 Normal Tunnel Operations

Normal operations would include passing all inflowing water downstream via either the 9-foot wide or 23-foot diameter discharge tunnels through MMD. These tunnels were modified in 1995 along with the project water intake control structure to reduce debris problems and to be more fish friendly.

Outmigrating juvenile salmon, steelhead and adult steelhead kelts[2] must pass the project through either the low-elevation, 9-foot wide horseshoe-shaped tunnel, or the higher elevation 23-foot diameter tunnel depending on reservoir storage conditions.

### 1.3.2 Impoundment for Flood Risk and Flow Management

Mud Mountain Dam would store floodwater during severe winter storms that might otherwise cause downstream flood damage. The Corps would operate MMD to avoid releasing flows in excess of 12,000 cfs as much as possible, with outflows in the range of 6,000-8,500 cfs more common. The control flow (channel capacity) on the Puyallup River at Puyallup gage for the purposes of regulating MMD is 50,000 cfs. Although channel capacity in the lower Puyallup is 50,000 cfs, MMD would be operated to avoid flows in excess of 45,000 cfs at this location on the rising limb of the hydrograph to provide a safety factor against forecasting errors. At times, the Corps would discontinue discharge at MMD entirely to minimize downstream flood damage. However, storm inflow to the channel is so high immediately downstream from the dam that it prevents the river channel from completely dewatering during such extreme operations (Corps 2013a). The Corps would also store water to manage debris that accumulates in the reservoir area during storm events. Stored water would later be released at a lower, controlled rate, along with stored sediments. Other maintenance activities include periodic repair to the lining of the tunnels that pass abrasive sediment laden water through the dam.

[2] Kelts are steelhead adults that survive after spawning and return to the ocean.

### 1.3.3 Large Wood Management

The forested watershed upstream of MMD produces substantial amounts of large wood (or large woody debris (LWD)) that is transported by the river to MMD. The Corps estimates 40,000 to 50,000 cubic yards of driftwood accumulate each year around the reservoir margins and at the trash rack. The LWD clearing is a necessary activity to prevent clogging of the intake structure and trash racks by debris too large to pass through the tunnels, and requires raising the pool level. This activity would typically be conducted soon after a flood event, i.e., during winter months. However, it may be conducted when a flow management impoundment occurs for repair of the fish passage barrier, for instance. On rare occasions (i.e., at intervals of at least several years), it may be necessary to create an impoundment for the primary purpose of LWD collection should wood accumulation in the reservoir represent a safety or maintenance issue. When a very large amount of LWD must be collected, such as fol1owing the 1995-1996 floods, the reservoir may be kept at high pool (1,080 feet) for a period as long as six weeks to facilitate collection. The Corps would make every effort to allow all LWD to pass through MMD, including breaking larger debris into smaller pieces or turning pieces to pass through the trash rack. The only debris that would be removed is that which is too large to pass through the large trash rack that protects the outlet tunnels. Management entails two components: floating debris collection and tunnel intake cleaning.

### 1.3.4 Fish Trap Operations

The Corps' fish trap has been in operation since prior to MMD's completion in 1948. The trap is located on the south bank of the White River, about 5.5 river miles downstream from MMD, at the site of the White River diversion dam (RM 24.3) and the Muckleshoot Indian Tribe (MIT) White River Hatchery. The Corps would continue to manage the facility to provide anadromous and resident migratory fish access to habitats upstream of MMD. Collected fish may be conveyed to the MIT hatchery (coded wire tagged Chinook salmon and steelhead), hauled to the upstream fish release site (untagged or unsampled Chinook salmon, coho salmon, pink salmon, wild steelhead and bull trout, as well as surplus hatchery salmon), or returned to the river downstream from the trap (some hatchery steelhead, hatchery fall Chinook, if detected, and some pink salmon). Transported fish would be returned to the river at a site located 5 miles upstream of MMD, at RM 35. Transport would be conducted within a total time span of about 0.5 to 2 hours, so water temperature in the truck would not significantly change during transport. The longest a fish may remain in the trap is three days, though the trap may be checked and fish transported multiple times daily during the peak of adult migration.

The trap and haul system is the only mechanism for anadromous fish to pass upstream of the White River diversion dam and MMD to access spawning and rearing habitats upstream of MMD.

Although included in the proposed action we consulted on in our 2007 opinion, the Corps no longer proposes to install a new fishway and trap, and instead proposes to continue using the existing facility for all upstream fish passage functions.



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### 1.3.5 White River Diversion Dam Repairs

When the White River diversion dam requires repairs due to debris impacts or high flows, the Corps would operate MMD to reduce White River flows to enable repair or maintenance by the CWA. This is not inevitable every year, but has been a regular occurrence over several years nonetheless, and may occur more than once a year. Cascade Water Alliance would perform the repairs, replacing loose or broken panels and/or removing any LWD transported by high flows into the dam, and the Corps would fund the work. This work is regarded as unscheduled, as opposed to scheduled maintenance that can be planned years in advance. The repairs would be to retain the diversion dam's ability to serve as a barrier to upstream migration and direct fish into the Corps' fish trap. Repairs may occur when flows are favorable (in winter, January 15-March 15) if possible, or during the established in-water work window of July 15-Aug 31. The Corps would cooperate with interagency (Puyallup Tribe of Indians (PTI), CWA, Pierce County, and others) fish rescue efforts that would take place as rampdown concludes in the reach downstream from the White River diversion dam, and would provide a report on each repair event, describing dewatering, fish rescue operation, and water quality, to NMFS, United States Fish and Wildlife Service (USFWS), MIT, PTI, Washington Department of Fish and Wildlife (WDFW), Washington Department of Ecology (WDOE), Pierce County and CWA.

### 1.3.6 Tunnel Repairs

Due to the high sediment loads, combined with unique hydraulic conditions at the project, the 9-ft tunnel has experienced extensive wear of the steel liner. Holes in the steel plate have formed and wear of the concrete at those locations occurs regularly. The Corps has identified a need to replace the steel liner to provide a long-term fix to this problem. The scope and design of the permanent repair would be determined after the completion of an ongoing study to determine suitability of materials to be used. Once the project is approved and construction begins, the 9-foot tunnel could be out of service for more than one year. However, the 9-foot tunnel is not needed for flood control operations.

To accomplish this work, discharge would be throttled back (ramped down) to allow the pool to raise 15 feet to reach the intake for the 23-foot tunnel. At that point, the 9-foot tunnel would be closed at the upper end, and all flows would be routed through the 23-foot tunnel for the several-months required to accomplish the repairs. For any necessary repairs of the 23-foot tunnel, it would be closed, and water would continue to flow normally through the 9-foot tunnel without interruption.

In the near term, the Corps would patch concrete scours in the 9-foot tunnel once or twice each year, as needed. To do so, the tunnel would be closed for about four to six weeks for the repairs to take place, including concrete cure time. Timing of the repairs would be dependent on the condition of the tunnel at the time of inspections (currently conducted every six to eight weeks), but may be at any time of the year

Although not currently planned, temporary patching of the 23-foot tunnel would take place as needed, on an unscheduled basis and take place any time of year. To accomplish this work, the 23-foot tunnel would be closed, and water would continue to flow normally through the 9-foot tunnel without interruption.

### 1.3.7 Woody Debris Management

The Corps has developed three storage areas along the margins of the project reservoir where it stores woody debris that is too large to safely pass downstream. The lower debris basin, covers about 20 acres on the right (north) bank and is not accessible via road and is used mainly as a holding area for collected LWD. The upper debris basin, covering about 60 acres on the right bank, is used as the terminal disposal area for all LWD collected in the reservoir. The middle basin provides a larger working area than the lower basin, and is accessible by road. Several thousand feet of sweep and containment booms are maintained in the three basins for collecting and storing LWD. At times when pool elevations reach 1,070 feet (generally associated with high inflows), all floatable LWD would be collected from the reservoir and its margins and towed to the area over the middle debris basin. At these times, two or more power vessels would be used to collect the LWD and tow it to storage positions over the debris basins where it would remain after the water recedes. Disposal operations would be initiated after the reservoir is subsequently evacuated.

A small portion of the accumulated wood could be considered salvageable LWD for use in habitat enhancement projects. Such salvageable LWD would be stockpiled and generally consists of large trees with extensive root structures, which are particularly useful for fish habitat improvements. Salvageable LWD is generally between 8 and 12 inches diameter at breast height (DBH) and between 20 and 80 feet long, though size and quality vary widely. Useful LWD would be used in habitat enhancement projects constructed by the Corps within the White/Puyallup Basin; habitat enhancement projects constructed by the Corps in other drainage basins; and habitat enhancement projects constructed by other interested parties, such as WDFW, WDOE, South Puget Sound Salmon Enhancement Group, Native American tribes and counties, regardless of where those projects are located. No such projects are proposed for construction on MMD project lands. In years following extraordinary floods, such as the flood of record in February 1996, extremely large volumes of wood may be collected. In such cases, some wood may be allocated to a third priority, which is salvage for timber, firewood and other uses. The Corps is in discussion with the MIT concerning salvage of wood.

Although the placement of LWD in restoration projects could have short-term, adverse effects on salmon species or their habitat, such effects would be subject to assessment and review of each restoration project by NMFS and are not related to the operation and maintenance of MMD. Because future restoration projects performed by other entities are not within the scope of the Corps' proposed action, these potential future effects are not addressed in this Opinion.

The LWD that is not useful for habitat enhancement projects would be burned in accordance with the requirements of Puget Sound Clean Air Agency regulations.

### 1.3.8 Repairs and Routine Maintenance

Other normal operations and maintenance activities that would be conducted by the Corps include maintenance of the recreational facilities at MMD, maintenance of roads and trails on project lands, and maintenance of the MMD structure itself and support facilities, other than as described above.

This work generally would not involve in-water work, flow manipulation, or changes to riparian features. Except for a foot and equestrian trail near the river, the recreational facilities are distant from the river and have no potential to affect listed species or their habitat. The trail would continue to receive little maintenance and has no identified potential to affect listed species or their habitat. Roads on project lands are for the most part distant from the river. The exceptions are the access roads on the upstream and downstream faces of MMD, and the access road to the upper debris basin. The road on the downstream face of MMD is paved at its lower end and the dirt road above has negligible potential to deliver sediment or spilled petrochemicals to the river. Maintenance of the MMD support facilities does not have the potential to cause any adverse effects to listed species, because such maintenance would be performed indoors, and the support facilities are distant from the river or its tributaries.

### 1.3.9 Monitoring and Adaptive Management

The Corps proposes to monitor the daily conditions at MMD, including: (1) weather data, (2) temperature, flow rate, and turbidity of waters passing through MMD, (3) the level of any impounded waters, and (4) the numbers of fish of each species that are caught at the fish trap, and the disposition of the trapped fish. Corps fisheries personnel would continue to conduct spot monitoring of other aspects of fish habitat and biology in the MMD project area.

The Corps would also review and respond to monitoring results derived from the work of other agencies active in the area, particularly the MIT, PTI, and WDFW. These agencies are included in ongoing discussions on flow management and sediment discharges in such a way as to minimize impacts to anadromous salmonids. These discussions provide an adaptive management mechanism for continued review and improvement of water management at MMD. While an adaptive management plan (ADP) is not proposed, the project would be adaptively managed in the sense that new information would be continually sought, documented, evaluated, and acted upon.

The Corps proposes to seek funding to evaluate juvenile fish passage rates through the 9-foot tunnel and the 23-foot tunnel. One objective would be to determine if preliminary results indicating lack of success passing the 9-foot tunnel by hatchery steelhead smolts can be replicated (R2 Resources 2013). The same evaluation may be necessary for the 23-foot tunnel, for which successful passage was indicated. Fish of unlisted species could be used as surrogates for listed fish. Funding is always a concern, however, and this work is not currently funded. Therefore, we do not rely on this part of the proposed action in our effects analysis and conclusion.

### 1.3.10 Replacing the Fish Barrier Structure

The Corps proposes to replace the existing White River diversion dam, which is in poor condition, with a new structure designed to provide a safe barrier to fish passage and to attract migrating adult salmonids into the Corps' fish trap, or the MIT hatchery trap, but has not specified a completion date. The Corps, NMFS, and USFWS have worked cooperatively on the new fish barrier design for several years and the Corps included a substantial amount of those design details in its proposed action (Corps 2013a, Section 2.9). The existing diversion dam is a relic from Puget Sound Energy's (PSE) former White River hydroelectric project and is now owned by CWA, a municipal water supply utility. The dam is not necessary to serve CWA's



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diversion needs, and today serves primarily as a fish barrier and guidance structure, to direct fish into the Corps' trap and haul facility, and for fishery management and hatchery purposes (to separate hatchery-origin fish from wild origin fish). The flow reductions needed to facilitate such repairs are environmentally damaging.

## 1.4 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02**).** The MMD Project action area is the White River and its tributaries from the upstream limit of anadromous fish access (upstream of MMD) downstream to the confluence of the White River with the Puyallup River and then to Commencement Bay in Puget Sound, all project works, the White River diversion dam and all of Puget Sound.


**Figure 2. Site Map for the Mud Mountain Dam consultation showing designated critical habitat in Puget Sound for Puget Sound Chinook salmon and southern resident killer whales. Source: NMFS staff.**

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

The ESA established a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS, NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Section 7(b)(3) requires that at the conclusion of consultation, the Service provide an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, then Section 7(b)(4) requires the provision of an ITS specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

## 2.1 Introduction to the Biological Opinion

NMFS's jeopardy analysis in this Opinion considers both survival and recovery of the species.

> "To jeopardize the continued existence of a listed species" means to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02).

For our destruction or adverse modification of critical habitat analysis, we do not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. [3] NMFS's destruction or adverse modification or critical habitat analysis considers the impacts to the conservation value of the designated critical habitat.

To reach our jeopardy and adverse modification determinations, we follow a 5-step process.

- *Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action.* This section describes the current status of each listed species and its critical habitat relative to the conditions needed for survival and recovery. For listed salmon and steelhead, NMFS developed specific guidance for analyzing the status of the listed species' component populations in a "viable salmonid populations" (VSP) paper (McElhany et al. 2000). The VSP approach considers the abundance, productivity, spatial structure, and diversity of each population as part of the overall review of a species' status. For listed salmon and steelhead, the VSP criteria include the species' "reproduction, numbers, or distribution" (50 CFR 402.02). In describing the range-wide status of listed species, we rely on viability assessments and criteria in technical recovery team documents and recovery plans, where available, that describe

[3] Memorandum from William T. Hogarth (NMFS, 2005c) to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005a).

how VSP criteria are applied to specific populations, major population groups, and species. We determine the rangewide status of critical habitat by examining the condition of its physical or biological features (also called "primary constituent elements" or (PCEs) in some designations) which were identified when the critical habitat was designated. The rangewide status and critical habitat status of ESA-listed species are in Section 2.2.

- *Describe the environmental baseline for the proposed action.* The environmental baseline includes the past and present impacts of Federal, state, or private actions and other human activities in the action area. It includes the anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation and the impacts of state or private actions that are contemporaneous with the consultation in process. (50 CFR 402.02) The environmental baseline is in Section 2.3.

- *Analyze the effects of the proposed actions.* In this step, NMFS considers how the proposed action would affect the species' reproduction, numbers, and distribution or, in the case of salmon and steelhead, their VSP characteristics. NMFS also evaluates the proposed action's effects on critical habitat features. The effects of the action are in Section 2.4.

- *Describe any cumulative effects.* Cumulative effects, as defined in NMFS' implementing regulations (50 CFR 402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation. Cumulative effects are in Section 2.5.

- *Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.* In this step, in consideration of the current rangewide status of the species and the status of their critical habitats (Section 2.2), NMFS adds the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to assess whether the action could reasonably be expected to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. Integration and synthesis occurs in Section 2.6.

- *Conclusions.* Following our assessment of the risk the proposed action presents to the continued existence of the species and its effects on their critical habitats, we present our conclusions in Section 2.7.

## 2.2 Range-Wide Status of the Species and Critical Habitat

The action area is within the evolutionarily significant unit (ESU) [4] and distinct population segment (DPS) [4] boundaries of three ESA-listed species within NMFS' jurisdiction; Puget Sound (PS) Chinook salmon, PS steelhead, and Southern Resident killer whales (SR killer whales) (Table 1). The action area includes designated critical habitat for PS Chinook and proposed critical habitat for PS steelhead, and the proposed action may affect designated critical habitat for SR killer whales by affecting their preferred prey (Chinook salmon). The biological requirements, life histories, migration timing, historical abundance, and factors for the decline of these species have been well-documented (Busby et al. 1996; Myers et al. 1998; West Coast Biological Review Team (WCBRT) 2003). The following sections summarize the relevant biological information for PS Chinook, PS steelhead, and SR killer whales.

**Table 1. Status of Puget Sound Chinook, Puget Sound steelhead, and SR killer whales and pertinent Federal Register notices.**

| Species/ESU/ DPS | Status/Review Date/ Federal Register Notice | Critical Habitat Designation Date/ Federal Register Notice | Protective Regulations Date/ Federal Register Notice |
|---|---|---|---|
| *Oncorhynchus tshawytscha* Puget Sound Chinook salmon | Threatened 8/15/11 70 FR 37160 | 9/02/05 70 FR 52630 | 6/28/05 70 FR 37160 |
| *Oncorhynchus mykiss* Puget Sound steelhead | Threatened 8/15/11 76 FR 50448 | Proposed 78 FR 2726 | Not applicable |
| *Orcinus orca* Southern resident killer whale | Endangered 4/14/2014 79 FR 20802 | 11/29/06 71 FR 69054 | 4/14/2011 76 FR 20870 |

### 2.2.1 Puget Sound Chinook

NMFS listed Chinook salmon in the Puget Sound ESU as threatened under the ESA in 1999. NMFS reaffirmed this listing in June 2005 (NMFS 2005). On August 15, 2011, NMFS

[4] An ESU, or evolutionarily significant unit, is a Pacific salmon population or group of populations that is substantially reproductively isolated from other nonspecific populations and that represents an important component of the evolutionary legacy of the species. NMFS' ESU policy (56 FR 58612) for Pacific salmon defines the criteria for identifying a Pacific salmon population as a distinct population segment (DPS), which can be listed under the ESA. A distinct population segment (DPS) is the smallest division of a taxonomic species permitted to be protected under the Endangered Species Act. Species, as defined in the Act for listing purposes, is a taxonomic species or subspecies of plant or animal, or in the case of vertebrate species, a distinct population segment (DPS).

completed its most recent five-year review for the PS Chinook salmon ESU (Ford et al. 2011), and concluded that the species should remain listed as threatened (76 FR 50448).

The ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound, including the Strait of Juan de Fuca. The ESU boundaries stretch from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound, and the Strait of Georgia in Washington, and includes fish from 22 independent populations and 26 artificial propagation programs (hatcheries). All naturally spawned Chinook salmon in all river reaches accessible to Chinook salmon in the White River basin, including White River hatchery spring Chinook, are part of the PS Chinook ESU. In 2006, NMFS identified the early run of White River Chinook as one of 11 demographically independent populations of Chinook that would have to achieve a highly viable status (low risk of extinction) for the PS Chinook salmon ESU to recover (NMFS 2006).

The Puget Sound Technical Recovery Team (PSTRT) identified White River Chinook as an independent population of the PS Chinook salmon ESU (PSTRT 2005). The White River population of PS Chinook exhibits the basic characteristics and biological requirements of PS Chinook salmon described in Meyers et al. (1998), and summarized below in this section.

Each of these 22 populations in this ESU is considered a "demographically independent population" that was identified using a number of criteria including: distinct trends in population abundance and variability, genetic separation, differences in life history characteristics and age structure, spatial and or temporal separation of spawners, unique habitat and hydrological characteristics of a watershed, and catastrophic risk (e.g. drainage located near volcano) (PSTRT 2005). However, many of their freshwater, estuarine, nearshore, or marine rearing life stages may overlap in both time and space.

Analysis of genetic material is commonly used as one of the key factors for determining population structure and assignment of particular individuals to a population. However, criteria for grouping versus separating populations based upon genetic similarities or differences are somewhat subjective and dependent upon the scale of the analysis. The PSTRT (Ruckelshaus et al. 2006) used a variety of metrics to examine genetic similarity among PS Chinook salmon populations, along with life history traits and geographic separation, in their determination of population independence. Genetic metrics included allele frequency analysis, estimates of divergence time in generations, and Cavalli-Sforza chord distance. Each of the metrics provided evidence regarding the relatedness of the populations, which the PSTRT integrated into their decision-making process. The PSTRT's premise was that population segments were independent unless the available information suggested they should be grouped. The PSTRT identified the White River population of Chinook salmon as one of 22 independent populations with the ESU's boundaries. NMFS adopted the PSRT's delineation of major population groups (MPGs) and demographically independent populations (DIPs) in the Puget Sound Salmon Recovery Plan (NMFS 2007b). NMFS also adopted the recovery goals in the Plan.

***Life History***

Chinook salmon juvenile life history patterns are typically grouped into "ocean-type" and "stream-type" (Healey 1991). Ocean-type juveniles outmigrate to marine waters as sub-yearlings, while stream-type juveniles rear in freshwater for at least a year. Most (80%) White



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River PS Chinook smolts outmigrate as subyearlings, making the population primarily ocean-type (Puget Sound Indian Tribes and WDFW 2009). Outmigrants captured in the traps at the CWA diversion screen bypass are about 38 mm in size.

***Abundance, Productivity, and Diversity***

The PSTRT mostly adopted the long-term abundance and productivity recovery targets developed by the WDFW and treaty tribe co-managers (NMFS 2006, Table 2). The targets are based upon two particular points on a Beverton-Holt stock recruitment curve developed for each population under average marine survival conditions. The high productivity target is the number of spawners needed to obtain maximum sustainable yield (MSY) and the low productivity target is the number of spawners needed at the point where the unit replacement line (1.0 recruit per spawner) crosses the curve. No specific abundance planning targets were set for the White River population.

Spatial, temporal, and genetic diversity is important for maintaining population viability because it reduces the risk that stochastic events such as landslides, droughts, or floods will adversely affect all components of a population. It allows populations to use a wider range of habitat patches, and genetic diversity allows the population to adapt to changing environmental conditions (McElhany et al. 2000). Diversity in the White River Chinook salmon population is expressed primarily through a combination of their age of outmigration and age of return, but also through the spatial distribution of habitat used by spawners and juveniles. Because the population has multiple life history strategies during outmigration (including fry, delta rearing, parr rearing, and yearling) and variable ages of return (primarily ages 2 through 5, plus the occasional age 6 fish), they express a diverse life history that helps them to persist in the event of relatively low survival in any particular location or period over their life cycles.

Puget Sound Chinook ESU natural spawning abundance was fairly stable from 1985 to 1990, declined during 1991−1999, increased from 2000 to 2004, and then decreased again from 2004 to 2009, with 2009 back down at the 1990s levels (Figure 2). The highest abundances were in 2002, 2004, and 2006. The year 2004 had the highest abundance, with 45,000 natural-origin spawners and 60,000 total (natural origin + hatchery) spawners. Hatchery fish contributed from 15 to 40% of the natural spawners for the ESU as a whole during these years (Ford 2011). Recent abundance trends for all PS Chinook stocks have been negative, measured as recruits per spawner (Ford 2011), with populations remaining well below technical recovery team (TRT) recovery escapement goals. PS Chinook have declined in abundance since the 2005 status review, and trends since 1995 have remained mostly flat (Ford 2011). Overall, new information on abundance, productivity, spatial structure, and diversity since the 2005 review does not indicate a change in the biological risk since the last review. The biological risk of extinction remains moderate.

***Limiting factors.*** Limiting factors described in Shared Strategy for Puget Sound (SSPS) (2007) include:

- Degraded nearshore and estuarine habitat: Residential and commercial development has reduced the amount of functioning nearshore and estuarine habitat available for salmon



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rearing and migration. The loss of mudflats, eelgrass meadows, and macroalgae further limits salmon foraging and rearing opportunities in nearshore and estuarine areas.

- Degraded freshwater habitat: Floodplain connectivity and function, channel structure and complexity, riparian areas and large wood supply, stream substrate, and water quality have been degraded for adult spawning, embryo incubation, and rearing as a result of cumulative impacts of agriculture, forestry, and development.
- Anadromous salmonid hatchery programs: Salmon and steelhead released from Puget Sound hatcheries operated for harvest augmentation purposes pose ecological, genetic, and demographic risks to natural-origin Chinook salmon populations.

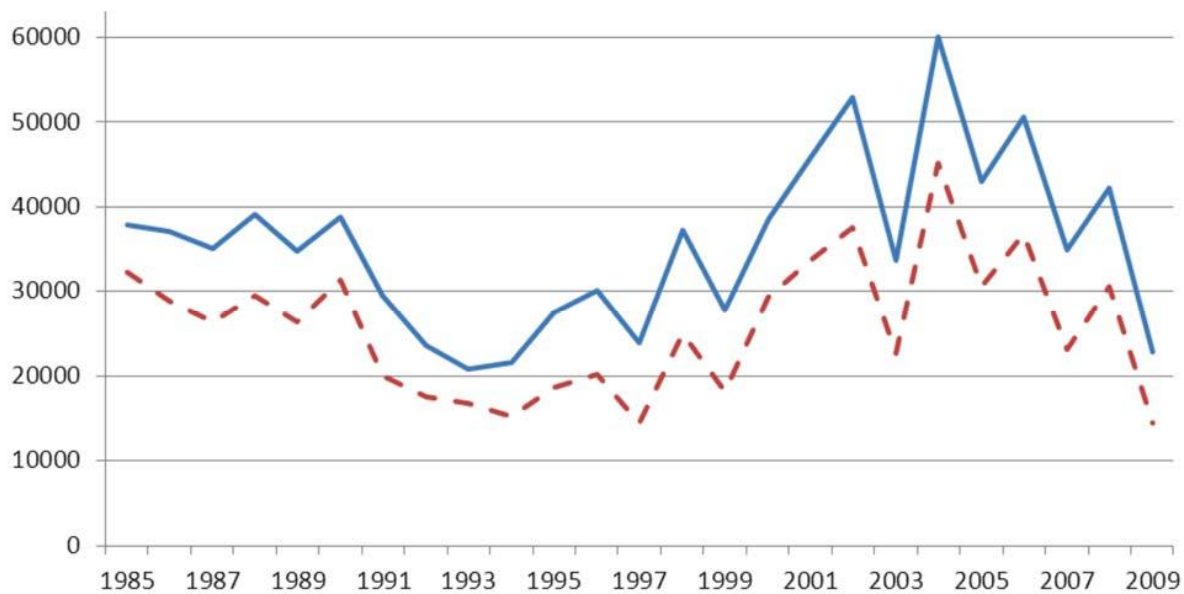


**Figure 3. Annual escapement of Puget Sound Chinook from 1984 through 2009. Natural-origin spawners shown in dashed line. Total spawners in solid line. Source: Ford 2011**

### *2.2.1.1 White River Population of PS Chinook Salmon*

The White River population suffered a severe decline in the 1970s through the 1980s (Figure 3) and risked extirpation were it not for artificial propagation. The recent abundance trend for the White River population is negative but somewhat better than that for the entire ESU (Figure 3 and Figure 4). The White River spawning escapement from 2005 to 2009 averaged 1306 natural origin recruits (NORs), with about 30% hatchery fish on the natural spawning grounds. The combined natural and hatchery total escapement averaged 1869 over this period (Ford 2011).



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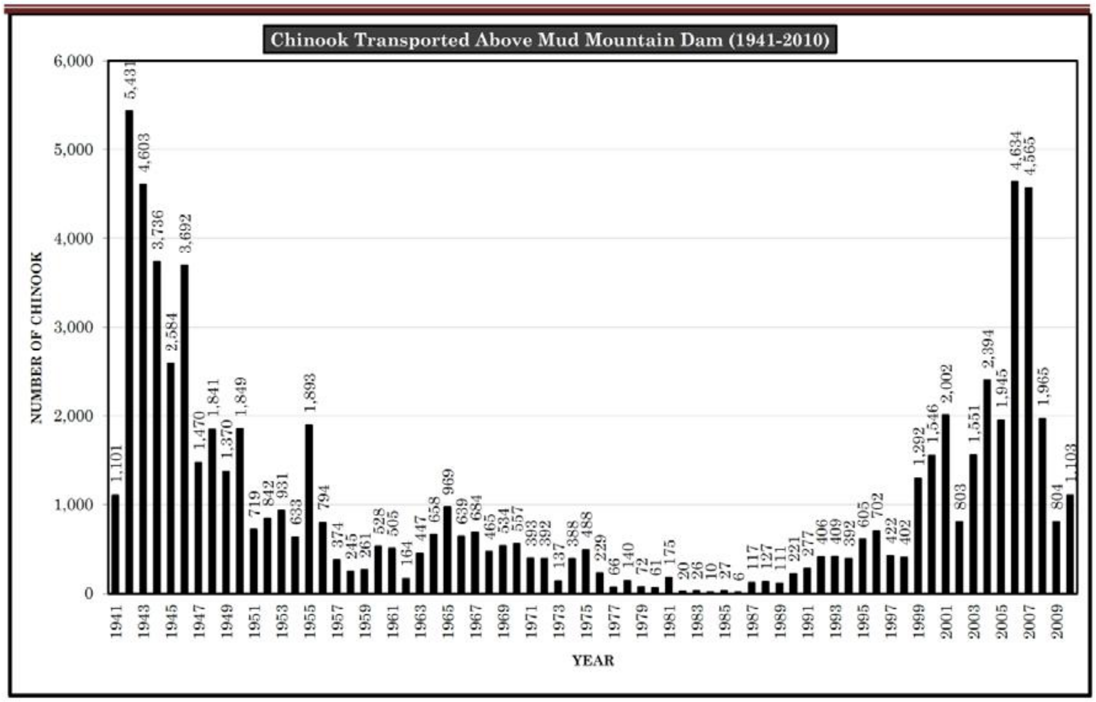


**Figure 4** **White River Chinook Salmon escapement 1941 through 2010. Source: Corps 2013a**

The White River supports two stocks of PS Chinook salmon, the spring and fall stocks. The earlier returning spring Chinook salmon from the White River are the last remaining spring stock in south Puget Sound. Spring Chinook salmon generally enter the river in April and commence spawning in both the lower and upper White River around September. The majority of spring Chinook salmon spawning occurs upstream from MMD in tributaries to the White River (WDFW & Western Washington Treaty Indian Tribes (WWTIT) 1994) where there is better spawning and rearing habitat. Fall Chinook salmon generally begin to enter the river later (August-September) and generally spawn in the White River and its tributaries downstream from the diversion dam beginning in October; (WDFW & WWTIT 1994, Shaklee and Young 2003). Chinook salmon fry begin to emerge from gravels in January through March in the White River and migrate through the White River in April and May (WDFW et al. 1996; Dunstan 1955). The majority (80%) of juvenile Chinook salmon migrate downstream as fry/fingerling (age-0+), based on adult scale analyses (unpublished data, Puyallup Indian Tribe as reported in R2 2014.).

The history of artificial production of White River Chinook is described in detail by Shaklee and Young (2003). Hatchery production, aimed specifically at restoring the White River Chinook population began in 1974, with fish collected at the Corps' trap being spawned and reared in isolation at WDFW's Voights Creek hatchery. Shaklee and Young (2003) provide evidence that between 1974 and 1976 this program was ineffective due to high pre-spawning mortality of adults and high rates of bacterial kidney disease in their progeny. As the population continued to decline, WDFW moved the program to its Minter Creek and Hupp Springs hatcheries and NMFS' Manchester captive brood program. Shaklee and Young (2003) state that "The combined efforts of these programs resulted in a substantial increase in the number of returning adults, and in 1997, spawning of adults at the Manchester facility was terminated." The White River spring-



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run Chinook programs at WDFW's Minter Creek and Hupp Springs hatcheries have the goal of ensuring the population persists and recovers. The current production targets for the Minter Creek/Hupp Springs hatchery complex and the MIT White River hatchery are 90,000 yearlings and 260,000 zero age juveniles from each (MIT 2003). The total broodstock collection goal is 259 females and 441 males (MIT 2003). Broodstock is collected both from the MIT hatchery fish trap and the Corps' fish trap, located on the right and left banks respectively, at the White River diversion dam.

Since opening in 1989, the Muckleshoot Tribe's White River hatchery has played a major role in the recovery program by producing and releasing pre-smolts both directly from the hatchery and from acclimation ponds in the upper White River (Shaklee and Young 2003). As shown in Figure 4, within a few years after the tribal hatchery began operating, numbers of returning adult White River Chinook salmon began to increase significantly. The White River hatchery's Chinook salmon program is intended to support recovery of the population to the point it can support a tribal fishery.

In summary, the status of PS Chinook salmon is that their overall numbers are decreasing throughout their range and several populations have been extirpated. The White River population of PS Chinook salmon is the southernmost population that is dominated by spring-run fish and is being supported by hatchery production.

***Rangewide Status of Critical Habitat for Puget Sound Chinook Salmon***

NMFS designated critical habitat for PS Chinook salmon on September 2, 2005, effective January 2, 2006 (NMFS 2006a). Designated critical habitat for PS Chinook salmon includes all of the mainstem White River from its confluence with the Puyallup River to the upstream limit of migration, as well as the accessible reaches of most tributaries to the White.

In our September 2, 2005 critical habitat designation (NMFS 2005b), NMFS further defined PCEs for listed salmon and steelhead as sites essential to support one or more life stages of the ESU (sites for spawning, rearing, migration, and foraging). These sites in turn contain physical or biological features essential to the conservation of the ESU (for example, adequate spawning gravels, water quality and quantity, side channels, forage species). Specifically, the PCEs (physical/biological features) of PS Chinook salmon critical habitat are:

1) Freshwater spawning sites with water quantity and quality conditions and substrate capable of supporting spawning, incubation and larval development.

2) Freshwater rearing sites with:
   - Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility,
   - Water quality and forage supporting juvenile development; and
   - Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and

overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival

4) Estuarine areas free of obstruction and excessive predation with:

- Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and saltwater, natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes supporting growth and maturation.

5) Nearshore marine areas free of obstruction and excessive predation with:

- Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The inland action area (White River watershed) for this consultation serves as spawning and rearing habitat and as a migration corridor for both juvenile and adult PS Chinook salmon. In our 2005 critical habitat designation process, we rated the upper and lower White River watersheds as having 'high' conservation value[5] for PS Chinook salmon (NOAA Fisheries 2005).

Critical habitat for PS Chinook salmon in the action area has increased in quantity and quality since the 1998 review because the White River Hydroelectric project was retired in January 2004, restoring nearly natural stream flows in the lower 21 miles of the White River. Critical habitat is otherwise largely unchanged from the date of listing in 2005 with legacy degradation from decades of forestry and urban development. At present, downstream from the White River diversion dam PCEs 1, 2, and 3 are improving, or have recently been improved due to the return of near-natural flows to the river reach downstream from the dam, although they remain at risk due to timber harvesting in the upper watershed and the operation of MMD. Primary Constituent Element 3 upstream of the White River diversion dam is poor due to poor performance of the dam and fish trap and haul system. The PCEs 1,2 and 3 are related because the impaired migration corridor past MMD (PCE 3) reduces Chinook salmon's ability to use high quality upstream spawning and rearing habitat (PCEs 1 and 2). The PCEs 4, and 5 are declining for reasons unassociated with the proposed action. The status of PS Chinook critical habitat in the action area is discussed in more detail later under the Environmental Baseline section (Section 2.3) of this opinion.

In summary, PS Chinook critical habitat in the action area is degraded mainly due to blockage of the migration corridor by the dams, and as a result of unsafe and ineffective passage to the majority of their historical spawning and rearing habitat upstream of MMD. Critical habitat is

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

also degraded due to extensive timber harvesting in the upper watershed, and has been improved by the retirement of the White River Hydroelectric Project in 2004, particularly downstream from the White River diversion dam, due to the return of near-natural flows to that river reach.

***Recovery Plan***

The Shared Strategy for Puget Sound published a Puget Sound Chinook Salmon Recovery Plan in December 2007 (NMFS 2007b). This plan identifies the White River basin as one of five biogeographical regions within the Puget Sound ESU to have unique physical and habitat features that have affected the common evolution of groups of Chinook salmon, making the White River population particularly important for ESU recovery.

The recovery plan adopts ESU and population level viability criteria recommended by the PSTRT (Ruckeshaus et al. 2002). The PSTRT's Biological Recovery Criteria will be met when the following conditions are achieved:

- All watersheds improve from current conditions, resulting in improved status for the species;
- At least two to four Chinook salmon populations in each of the five biogeographical regions of Puget Sound attain a low risk status over the long-term;
- At least one or more populations from major diversity groups historically present in each of the five Puget Sound regions attain a low risk status;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario;
- Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery.

The PSTRT determined that all 22 populations of Chinook salmon currently are at high risk. The ESU viability criteria recommended by the PSTRT do not require that all 22 populations reach a low risk status over time, but all of them have to improve from current conditions. Accordingly, most watershed planners in areas with independent populations of Chinook chose to work toward low risk status for their populations to get on a recovery trajectory during the next 10 years and as a precautionary approach to eventually recover the entire ESU (NMFS 2006). Table 2 shows the 22 extant populations in each biogeographical region and relates them to the PSTRT's ESU viability criteria.



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**Table 2. Extant Puget Sound Chinook salmon populations in each geographic region (NMFS 2006)**

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

NOTE: NMFS has determined that the bolded populations need to be at low risk for ESU viability. In addition, at least two other populations within the Whidbey Basin region would need to be viable for recovery of the ESU.

NMFS recently completed a review of the ongoing implementation of the recovery plan (Judge 2011) identifying progress through 2010 toward implementing the plan including actions within the action area for this consultation. Recovery actions that have been completed are part of the environmental baseline for this consultation. Our five-year review of progress in implementing the recovery plan, NMFS (Judge 2011) identified the following accomplishments:

- The Co-Managers (the WDFW and Puget Sound Treaty Tribes, collectively) met or exceeded the harvest management performance measures required in the 2004 Harvest Management Plan.
- The WDFW completed its 21st Century Salmon and Steelhead Initiative, which will help them identify, monitor and evaluate long-term, science-based hatchery management strategies.
- Numerous high priority habitat restoration projects have been accomplished across every watershed in Puget Sound.
- The Nisqually watershed completed a major portion of their largest project, the Nisqually Refuge Estuary restoration project, with the support and shared contribution of funds from other South Sound watershed groups.



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- The Elwha River Dam removal project is finally funded and scheduled for demolition next year (2011).[6]
- The local commitment to salmon recovery across the ESU remains firm and work is continuing despite a severe recession, significant change in the organizational structure supporting Puget Sound salmon recovery, a loss of staff and severe funding shortages. Actions within the White River sub-basin that have benefited White River Chinook include:

    - removing the Howell Bunger valves at MMD in the mid-1990s (Corps);
    - screening the water diversion to Lake Tapps (Puget Sound Energy);
    - development and operation of the Muckleshoot Tribal hatchery (MIT);
    - incrementally restoring more instream flow to the bypass reach of the White River in 1988, 1999, and 2004 (Puget Sound Energy).

Recovery actions that have not been done, and that would benefit the White River population would be to provide safe and effective upstream and downstream passage to important spawning and rearing habitat. These measures include replacing the White River diversion dam, and constructing and operating a new Corps' fish passage facility with greater fish handling capacity and sorting ability, and providing effective downstream passage.

***Summary***
In summary, the White River demographically independent population is essential to survival and recovery of the PS Chinook ESU. In order for this ESU to reach the point where it can be delisted, the White River population of PS Chinook salmon must achieve a low risk status. This population is currently at high risk, the abundance of the population is declining, important parts of critical habitat are degraded or inaccessible, and the species is not achieving the recovery criteria (NMFS 2006, NMFS 2007b).

### 2.2.2 Puget Sound Steelhead

NMFS listed Puget Sound steelhead as threatened on May 11, 2007 (NMFS 2007c). On August 15, 2011, NMFS completed its most recent five-year review for the PS steelhead DPS, and concluded that the species should remain listed as threatened (76 FR 50448) The DPS includes all naturally spawned anadromous winter-run and summer-run steelhead populations in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). The Puget Sound steelhead DPS includes 3 major population groups (Northern Cascades, Central and Southern Cascades, and Hood Canal and Strait of Juan de Fuca), and 32 DIPs of summer- and winter-run fish (NMFS, 2010), the latter being the most widespread and numerous of the two run types. The majority of hatchery stocks are not part of this DPS because they are more than moderately genetically diverged from the local native populations. Resident *O. mykiss* (rainbow trout) occur within the range of Puget Sound steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and

[6] Elwha Dam removal was completed in 2012 and the Glines Canyon Dam removal is completed. The Elwha River now flows unimpeded from its headwaters in Olympic National Park to the Straits of Juan de Fuca, opening access to more than 70 miles of anadromous fish habitat.

behavioral characteristics (NMFS 2006a). There are two genetically distinct forms of *O. mykiss*, inland and coastal (Scott and Gill 2008). White River steelhead belong to the coastal form found west of the Cascade Mountains. Populations have been defined based upon run timing (winter, summer) and geographic location. The White River steelhead population is part of the Central and Southern Puget Sound MPG and is a winter run that spawns in the mainstem between River Mile (RM) 1 and 60 plus most accessible tributaries.

***Life History, Spatial Structure, and Diversity***

Within the range of West Coast steelhead, spawning migrations occur throughout the year, with seasonal peaks of activity. In a given river basin there may be one or more peaks in migration activity, and these ‘‘runs’’ are usually named for the season in which the peak occurs (e.g., winter, spring, summer, or fall steelhead). Steelhead can be divided into two basic reproductive ecotypes, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner et al., 1992). The summer or ‘‘stream-maturing’’ type enters fresh water in a sexually immature condition between May and October, and requires several months to mature and spawn. The winter or ‘‘ocean-maturing’’ type enters fresh water between November and April with well-developed gonads and spawns shortly thereafter. In basins with both summer and winter steelhead runs, the summer-run generally occurs where habitat is not fully utilized by the winter-run, or where an ephemeral hydrologic barrier separates them, such as a seasonal velocity barrier at a waterfall. Summer steelhead usually spawn farther upstream than winter steelhead (Withler, 1966; Behnke, 1992).

Hatchery-origin steelhead in the Puget Sound eco-region are widespread, spawn naturally throughout the region, and are largely derived from a single stock (Chambers Creek). With two exceptions (unrelated to Chambers Creek stock), hatchery steelhead are not part of the listed DPS in Puget Sound. The proportion of spawning escapement comprised of hatchery fish has ranged from less than 1 % (Nisqually River) to 51 % (Morse Creek) during the period 1984-92 (Busby et al. 1996). In general, hatchery proportions are higher in drainages entering Hood Canal and the Strait of Juan de Fuca than in those entering Puget Sound proper. Most of the hatchery fish in this region originated from stocks indigenous to the DPS, but are generally not native to local river basins (NMFS 2007c). Steelhead have not been stocked in the White River for many years.

White River steelhead enter the river beginning in November (NMFS 2005c). Spawning occurs from March through June with peak spawning occurring during May. Fry emergence peaks in early August. About 82 % of winter steelhead in the river undergo smoltification and outmigration at age 2 and about 18 % outmigrate at age 3 (NMFS 2005c). Outmigration occurs primarily from late April through early June.

Most (about 57%) White River winter steelhead spend one winter in the ocean before returning to the river the following winter to spawn (Scott and Gill 2008). A substantial proportion of the population (about 42%) returns after two winters in the ocean, with the remainder (about 1%) returning after three winters. In combination with the age at outmigration, the highest proportion (about 44%) of returning adult winter steelhead are age 4 (primarily 2.2 [2 years freshwater, 2 years saltwater]), followed by about 26% age 5 (primarily 2.3). Most White River winter steelhead dies after spawning. However, a small, but significant number of steelhead return to the ocean as kelts and may be repeat spawners. Scott and Gill (2008) reported that up to 14 % of the winter steelhead run may be repeat spawners with an average of 6 %.

General habitat use during freshwater rearing by steelhead is described in (Scott and Gill (2008). Steelhead may use a variety of habitat types, but often use higher velocity water and migrate farther into headwaters than other salmon, which is why steelhead are more widely distributed in the higher gradient tributaries within the White River than Chinook, coho, pink, or chum salmon. As steelhead juveniles grow, they tend to move away from stream edges and towards faster moving water and may move downstream to larger streams if crowding occurs. During winter, many steelhead juveniles will move back into smaller tributaries to avoid high flows and utilize structures such as boulders, LWD jams, root-wads, and undercut banks as cover.

Tracking of acoustic-tagged White River steelhead juveniles indicate they spend relatively little time in the lower White River or Commencement Bay (R2 Resources 2013). Wild steelhead migrate through the lower river and estuary over a few hours to less than a week.

There is very little information on steelhead egg to fry or fry to smolt survival rates in the White River. Similar to Chinook salmon described above, it is generally understood that river flows and fine sediment are important factors that may adversely affect these life stages (Bjornn and Reiser 1991). However, the magnitude and frequency of adverse effects of peak flows and scour on steelhead are likely to be less than for Chinook salmon because of the location and timing of spawning and incubation. Considering both fall- and spring-run fish, spawning and incubation of Chinook salmon eggs occurs during mid-July through January (WDFW and WWTIT 1994) and during the latter part of this period floods from rain-on-snow events can be severe. In contrast, steelhead eggs incubation occurs during the spring and early summer when flows are moderately elevated, primarily from annual winter snow pack melt. Consequently, incubating Chinook salmon eggs and alevins are more likely to be severely affected from peak flows than steelhead. On the other hand, steelhead juveniles typically have a longer freshwater residence period than Chinook salmon juveniles, especially those Chinook salmon that outmigrate as sub-yearlings, and thus may have a higher risk of being affected by natural and human-caused disturbances in the freshwater system.

***Abundance and Productivity***

For all but a few demographically independent populations of PS steelhead, populations are small and declining. Estimated mean population growth rates obtained from observed spawner or redd counts are declining—typically 3 to 10% annually—and extinction risk within 100 years for most populations in the DPS is estimated to be moderate to high, especially for populations in the south Puget Sound and Olympic MPGs. Collectively, these analyses indicate that steelhead in the Puget Sound DPS remain at moderate risk of extinction throughout all or a significant portion of their range (Ford 2011).

***Limiting Factors.*** NMFS, in its listing document of 2011 (76 FR 1392 (1/10/11)), noted that the factors for decline for Puget Sound steelhead also persist as limiting factors:

- In addition to being a factor that contributed to the present decline of Puget Sound steelhead populations, the continued destruction and modification of steelhead habitat is the principal factor limiting the viability of the Puget Sound steelhead DPS into the foreseeable future.

- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years.
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania) inconsistent with wild stock diversity throughout the DPS.
- Declining diversity in the DPS, including the uncertain but weak status of summer-run fish in the DPS.
- A reduction in spatial structure for steelhead in the DPS.
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris.
- In the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, it has caused increased flood frequency and peak flows during storms, and reduced groundwater-driven summer flows. Altered stream hydrology has resulted in gravel scour, bank erosion, and sediment deposition.
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, have increased the likelihood of gravel scour and dislocation of rearing juveniles.

#### *2.2.2.1 White River Population of PS Steelhead*

Relative to other populations in the DPS, the White River supports a small to moderate run of winter steelhead in the Puget Sound DPS (Figure 5). Most Puget Sound steelhead populations, including the White River, have had severe declines in recent years (Ford 2011). Recent escapement [7] levels are substantially lower than occurred in the 1980s and continue to show a downward trend. [8] Ford (2011) estimated an exponential population trend of 0.938 between 1985 and 2009 and 0.933 for the years 1995 through 2009 for White River steelhead, indicative of declining population abundance. The geometric mean population from 2005 through 2009 was 265 (Ford 2011) and the mean annual population growth rate between 1985 and 2009 was -0.064, indicative of a 90% probability of decline to 10% of the current population within 50 years. However, Ford (2011) expressed that risk projections beyond the next 20 years are highly uncertain.

[7] "Escapement" is the portion of an anadromous fish population that escapes commercial and recreational fisheries to reach the freshwater spawning grounds.
[8] Since the 2004 retirement of the White River Hydroelectric Project, which severely impacted the White River downstream from the Buckley diversion dam, the White River population of PS steelhead has grown modestly. It is too early to tell whether this is a population response to improved environmental conditions, or simply an expression of natural variation in the population.

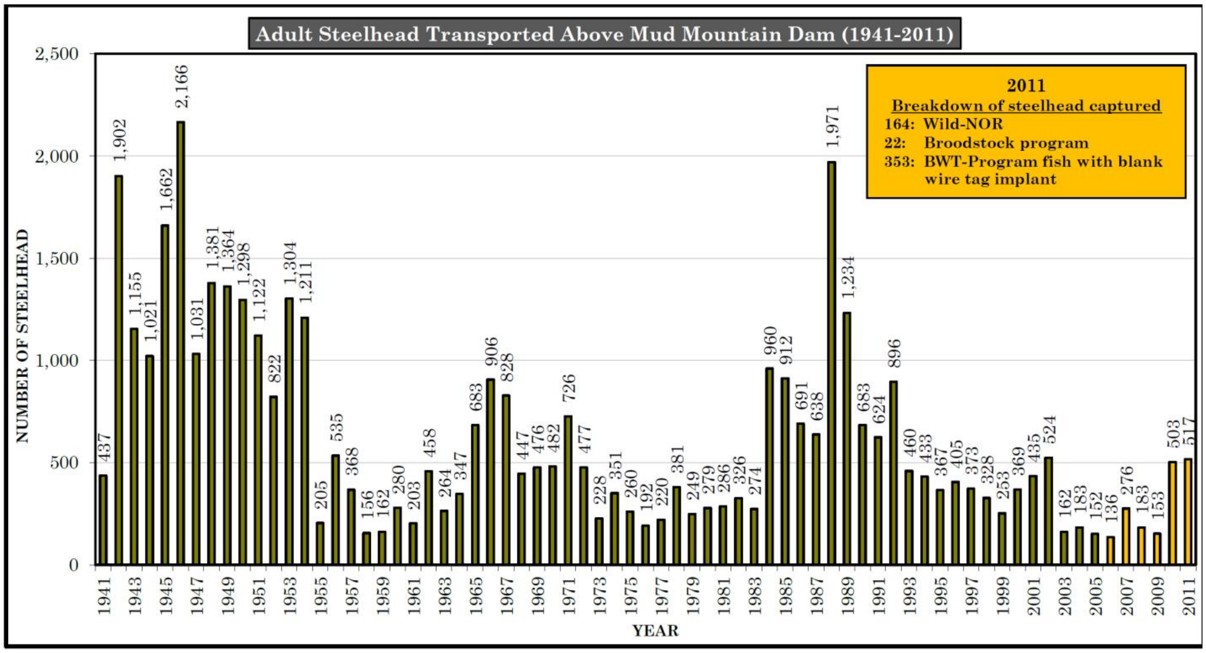


**Figure 5.** **White River wild steelhead escapement. Source: Corps 2013a**

The Puget Sound steelhead TRT has not finalized viability criteria for this DPS. Due to declines in population abundance and productivity, the DPS continues to exhibit a widespread declining trend, including the White River population.

***Proposed Critical Habitat***

Proposed critical habitat for PS steelhead (78 FR 2726, NMFS 2013) is almost identical to that for PS Chinook salmon, including habitat areas suitable for spawning, rearing, and unobstructed migration corridors to and from spawning and rearing habitats. Steelhead proposed critical habitat in the action area, has also benefited from the recent restoration of near-natural streamflows downstream from the White River diversion dam, and continues to be degraded by the legacy effects of logging in the upper White River watershed and blocked migration corridors to spawning and rearing habitat. In our proposed critical habitat designation, we considered the upper and lower White River watersheds to have 'high' conservation value for PS steelhead (NOAA Fisheries 2012).

***Recovery Plan***

Recovery planning for this DPS is ongoing. In 2010, NMFS gave PS steelhead a recovery priority of 1 (NMFS 2010a), its highest priority. Population viability analyses have shown that all three of the MPGs are at very low viability (PSSTRT 2013), making the likelihood for extinction moderate to high. Recovery would require highly viable DIPs in all three MPGs. Detailed analysis of population viability has shown that while the viability of the White River DIP is low (0.49), it is the highest among all the DIPs in the Central and Southern Cascades MPG. Given this viability ranking and other factors, we consider it very likely that the final recovery plan for this DPS will identify the White River DIP as essential to the recovery of the

Central and Southern Cascades MPG and the species as a whole. For this reason, we treat recovery of the White River DIP as essential to the recovery of the species in this Opinion.

***Summary***

In summary, the White River population is essential to recovery of the DPS. The status of PS steelhead DPS is that it remains at a moderate to high risk of extinction, access to important upstream critical habitat is limited, and the number of recruits per spawner is often less than one, meaning the population abundance is declining.

### 2.2.3 Southern Resident Killer Whales

NMFS listed the SR killer whales DPS, composed of J, K, and L pods, as endangered under the ESA on November 18, 2005 (70 FR 69903). The final rule listing SR killer whales as endangered identified several potential factors that may have caused their decline or may be limiting recovery. These include declining quantity and quality of prey, toxic chemicals that accumulate in top predators, and disturbance from sound and vessel traffic. The rule also identified oil spills as a potential risk factor for this species. The final recovery plan (NMFS 2008) includes more information on these potential threats to SR killer whales. This section summarizes information taken largely from the recovery plan and recent 5-year status review (NMFS 2011a), as well as new data that have become available more recently.

The SR killer whale DPS is composed of a single population that ranges as far south as central California and as far north as Southeast Alaska. From late spring to early autumn, SR killer whales spend considerable time in the Salish Sea (Strait of Georgia, Strait of Juan de Fuca, and Puget Sound. Bigg 1982, Ford *et al.* 2000, Krahn *et al.* 2002, Hanson and Emmons 2010), with concentrated activity around the San Juan Islands. During fall and early winter, Southern Resident pods, and J pod in particular, expand their routine movements into Puget Sound, likely to take advantage of chum and Chinook salmon runs (Hanson *et al.* 2010, Osborne 1999). During late fall, winter, and early spring, the ranges and movements of the SR killer whales are less known. Sightings through the Strait of Juan de Fuca in late fall suggest that activity shifts to the outer coasts of Vancouver Island and Washington (Krahn *et al.* 2002).

SR killer whales are a long-lived species, with late onset of sexual maturity (NMFS 2008). Females produce a low number of surviving calves over the course of their reproductive life span (Bain 1990, Olesiuk *et al.* 1990). Southern Resident females appear to have reduced fecundity relative to Northern Residents; the average interbirth interval for reproductive Southern Resident females is 6.1 years, which is longer than that of Northern Resident killer whales (Olesiuk *et al.* 2005). Mothers and offspring maintain highly stable social bonds throughout their lives, which is the basis for the matrilineal social structure in the SR population (NMFS 2008). Groups of related matrilines form pods. All SR killer whales are individually identifiable by photo-identification based on uniquely shaped and scarred dorsal fins and saddle patches. Vocal communication is advanced in killer whales and is important to their social structure, navigation and foraging (NMFS 2008).

The best available information indicates that salmon are the primary prey of killer whales (a high percent of prey consumed during spring, summer and fall, from long-term study of resident killer whale diet; (Ford and Ellis 2006), and that Chinook are the preferred salmon species (Ford and

Ellis 2006, Hanson et al. 2010). In inland waters from May to September, SR killer whales' diet consists of a high percentage of Chinook, with an overall average of 88% Chinook salmon across the timeframe and monthly proportions as high as >90% Chinook salmon (i.e., July: 96% and August: 91%, see Table 2 of Hanson et al. 2010). Killer whales also capture larger Chinook salmon (primarily age 3-5 years; Ford and Ellis 2006). SR killer whales likely consume both natural and hatchery salmon (Hanson et al. 2010). Fecal samples are also available in Hanson *et al.* (2010) but were not used to estimate proportion of the SR killer whales' diet, because the data from these samples represents presence or absence of prey species, but not proportion of diet. DNA quantification methods can be used to estimate the proportion of diet from fecal samples (*i.e.*, Deagle *et al.* 2005). This technique is still in the developmental stages. However, preliminary DNA quantification results from Hanson *et al.* (2010) samples indicate that Chinook make up the bulk of the prey DNA in the fecal samples (Ford *et al.* 2011).

The historical abundance of Southern Resident killer whales is estimated to have been at least 140 individuals. We do not know what the maximum may have been. The minimum historical estimate (~140) included whales killed or removed for public display in the 1960s and 1970s added to the remaining population at the time the captures ended. Several lines of evidence (*i.e.*, known kills and removals [Olesiuk *et al.* 1990], salmon declines [Krahn *et al.* 2002] and genetics [Krahn *et al.* 2002, Ford *et al.* 2011]) all indicate that the population used to be much larger than it is now, but there is currently no reliable estimate of the upper bound of the historical population size. When faced with developing a population viability analysis for this population, NMFS' biological review team found it reasonable to assume an upper bound of as high as 400 whales to estimate carrying capacity (Krahn *et al.* 2004).

As of April 2014, there were 80 whales in the SR killer whales population. A delisting criterion for the SR killer whales DPS is an average growth rate (R, where lambda = 1 +R) of 2.3 percent for 28 years (NMFS 2008). Although recent estimates of population growth (lambda) are positive (average of 1.01; Ward et al. 2013), the recovery criterion has not yet been met (NMFS 2011a) and the recent estimates are not sufficient to achieve recovery. There are also several demographic factors of the SR population that are cause for concern, namely the small number of breeding males (particularly in J and K pods), reduced fecundity, decreased sub-adult survivorship in L pod, and the total number of individuals in the population (NMFS 2008). The estimated effective size of the population (based on the number of breeders under ideal genetic conditions) is very small at approximately 26 whales, or roughly 1/3 of the current population size (Ford *et al.* 2011). The small effective population size and the absence of gene flow from other populations may elevate the risk from inbreeding and other issues associated with genetic deterioration, as evident from documented breeding within pods (Ford *et al.* 2011). The small effective population size may also contribute to the lower growth rate of the Southern Resident population in contrast to the Northern Resident population (Ford *et al.* 2011, Ward *et al.* 2009).

When prey is scarce, whales likely spend more time foraging than when it is plentiful. Increased energy expenditure and prey limitation can cause nutritional stress. Nutritional stress is the condition of being unable to acquire adequate energy and nutrients from prey resources and as a chronic condition can lead to reduced body size and condition of individuals and lower reproductive and survival rates of a population (*e.g.*, Trites and Donnelly 2003). The Center for Whale Research has observed the very poor body condition in 13 members of the Southern

Resident population, and all but two of those whales subsequently died (Durban *et al.* 2009). Both females and males across a range of ages were found in poor body condition (Durban *et al.* 2009).

Ford *et al.* (2005 and 2010) evaluated 25 years of demographic data from Southern and Northern Resident killer whales and found that changes in survival largely drive their population trends, and the populations' survival rates are strongly correlated with coast-wide availability of Chinook salmon (from Pacific Salmon Commission (PSC) abundance indices that estimate abundance between Southeast Alaska and Oregon). More recently, Ward et al. (2013) considered new stock-specific Chinook salmon indices and found strong correlations between the indices of Chinook salmon abundance and killer whale demographic rates. However, no single stock or group of stocks was identified as being most correlated with the whales' demographic rates. Further, they stress that the relative importance of specific stocks to the whales likely changes over time (Ward *et al.* 2013).

The SR killer whales population displays low population abundance and very low population growth, well below minimum numbers and growth rates needed for recovery, due in part, to declines in the populations of their main prey species, Chinook salmon.

***Rangewide Status of Critical Habitat for SR killer whales***
SR killer whales critical habitat was designated on November 29, 2006 (71 FR 69054) and includes three specific marine areas of inland waters of Washington: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Southern Resident critical habitat is within the following counties: Clallam, Jefferson, King, Kitsap, Island, Mason, Pierce, San Juan, Skagit, Snohomish, Thurston, and Whatcom. NMFS identified three PCEs essential for the conservation of SR killer whales:

- Water quality to support growth and development;
- Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development and to support population growth; and
- Passage conditions to allow for migration, resting, and foraging.

Mud Mountain Dam has minimal influence on the water quality of the southern Puget Sound area and has no influence on marine migration conditions. However, to the extent that the proposed action would affect the numbers of Chinook salmon in Puget Sound and the Strait of Juan de Fuca, it would affect SR killer whales prey abundance PCE. The contribution of Chinook salmon from the White River to the whale's diet is unknown; however, the White River population is an early run and must traverse a large portion of the SR killer whale inland range, making them highly available to whale predation. It is therefore likely that PS Chinook salmon from the White River are an important part of the whale's diet, or would be an important part of their diet if the PS Chinook population were to meet its recovery goal for abundance.

***Summary***
SR killer whales are endangered, their numbers are well below those needed for recovery, and critical habitat is adversely affected by decreasing numbers of prey species, Chinook salmon.

### 2.2.4 Climate Change

Unless otherwise cited, the following information about ongoing climate change, and likely salmon and steelhead responses to that change, comes from ISAB (2007) and Dalton et al. (2013).

Ongoing and future climate change has the potential to alter aquatic habitat throughout the Pacific Northwest region. These effects would be evidenced by alterations of seasonal water yields, peak flows, and stream temperatures. Other effects, such as increased vulnerability to catastrophic wildfires, may occur as climate change alters the structure and distribution of forest and aquatic systems. Given the increasing certainty that climate change is occurring and accelerating (IPCC 2007; Battin et al. 2007), one can no longer, assume that climate conditions in the future will closely resemble those in the past.

In Washington State, most models project warmer air temperatures, increases in winter precipitation, and decreases in summer precipitation. Average temperatures in Washington are likely to increase 0.1-0.6ºC per decade (Mote and Salathé 2009). Warmer air temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, seasonal hydrology will shift to more frequent and severe early large storms, changing stream flow timing and increasing peak river flows, which may limit salmon survival (Mantua et al. 2009). The largest driver of climate-induced decline in salmon populations is projected to be the impact of increased winter high flow events, particularly west of the Cascades, which scour the streambed and destroy salmon eggs (Battin et al. 2007).

In a study to predict impacts of climate change on salmon habitat in the region, model results indicate a large negative effect on freshwater salmon habitat driven by increased winter peak flows that scour the streambed and destroy salmon eggs (Battin et al. 2007). Higher summer water temperatures, lower spawning flows, and higher magnitude of winter peak flows are all likely to decrease salmon productivity in the Puget Sound and in hydrologically similar watersheds throughout the northwest. This is expected to make recovery targets for these salmon populations more difficult to achieve. Recommendations to mitigate the adverse impacts of climate change on salmon include: 1) restoring connections to historical floodplains and freshwater and estuarine habitats to provide refugia for fish and storage for excess floodwaters; 2) protecting and restoring riparian vegetation to ameliorate stream temperature increases; and 3) purchasing or applying easements to lands that provide important cold water or refuge habitat (ISAB 2007; Battin et al. 2007).

Higher ambient air temperatures, particularly during the summer, will likely cause water temperatures to rise (ISAB 2007). Salmon and steelhead require cold water for spawning and incubation. Suitable spawning habitat is often found in accessible higher elevation tributaries and headwaters of rivers. In addition, as climate change progresses and stream temperatures warm, thermal refugia will be essential to persistence of many salmonid populations. Thermal refugia provide important patches of suitable habitat for salmon and steelhead that will allow them to undertake migrations through or to make foraging forays into areas with greater than optimal temperatures. To avoid waters above summer maximum temperatures, juvenile rearing may increasingly be found only at the confluence of colder tributaries or other areas of cold-water refugia.

There is still a great deal of uncertainty associated with the timing, location and magnitude of future climate change. It is also likely that the intensity of effects will vary by region (ISAB 2007); however, several studies indicate that climate change has the potential to affect ecosystems in nearly all tributaries throughout the state of Washington (ISAB 2007; Battin et al. 2007; Rieman et al. 2007). The effects from future land use changes combined with climate change may further hinder salmon survival and recovery. These potential effects relate to White River Chinook salmon, and as a result, may reduce prey availability for SR killer whales.

Habitat actions can help address the adverse impacts of climate change on salmon. Examples include restoring connections to historical floodplains and freshwater and estuarine habitats to provide fish refugia and areas to store excess floodwaters, protecting and restoring riparian vegetation to ameliorate stream temperature increases, and purchasing or applying easements to lands that provide important cold water or refuge habitat (Battin et al. 2007; ISAB 2007). Because stream water temperatures decrease with increasing elevation and because cool water is important for spawning and rearing success, improving access to high elevation habitats is an important management objective for responding to climate change. Harvest management regimes and frameworks respond to changing conditions associated with climate change by incorporating uncertainty in environmental conditions and conservative assumptions about salmon survival in setting management objectives and allowable harvest levels. Managers revise management objectives on a regular basis to incorporate the most recent information on population productivity and capacity where that information is available.

## 2.3 Environmental Baseline

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 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline includes the effects of both human and natural factors affecting the present status of the species and critical habitat, but does not incorporate impacts specific to the proposed action (continued operation and maintenance of the Mud Mountain Dam Project).

In this Opinion, the baseline includes the effects of those parts of the Corps' 2007 proposed action that have been implemented (the Corps did not complete design, construction and operation of the new fish barrier or trap and haul facility, as proposed in its 2007 BA and analyzed in our 2007 Opinion). However, future impacts resulting from the future operation and maintenance of the project, and other activities listed in the proposed action are not part of the environmental baseline. Rather, the environmental baseline includes the current status of the species, and the factors currently affecting the species, within the action area. The resulting "snapshot" of the species' health within the action area provides the relevant context for evaluating the anticipated effects of the proposed actions on the ESU's and DPS' likelihood of survival and recovery relative to their biological requirements.

Below we present a more detailed description of specific elements of the environmental baseline within the project action area.



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### 2.3.1 Overview of the Environmental Baseline

The White River is a sub-basin of the Puyallup River basin, and the lower reach is in an urbanized area. The majority of the White River sub-basin upstream of Auburn, Washington (the upper reach) is rural and predominately forested.

The headwaters of the White River originate in the north-facing protected areas of Mt. Rainier National Park and wilderness areas of the national forest. Most of the upper basin Chinook salmon (and steelhead) spawning reaches are surrounded by private and public forests managed exclusively, or in part, for timber production. As a result, the effects of logging and road building are prevalent throughout the major spawning areas. The anthropogenic effects on habitat increase in the downstream direction. Rip-rapped and leveed-river banks begin just upstream of the diversion dam, and become more frequent from that point downstream. The river is almost entirely within levees downstream from the City of Auburn. There is very little spawning that occurs downstream of this point. The lowermost river reach (from RM 0 to RM11) is urban and suburban in nature, with commercial development along the banks. Spawning and rearing fish make very little use of this section of river (PTF 2013). It serves primarily as a migration corridor.

The White River flows through a series of glacial deposits and the remains of the Osceola Mudflow, which covers the White River valley to a depth of 25 feet. The geologically recent mudflow of approximately 5,700 years ago characterizes the White River as a "young river." As such, it is still in the process of cutting a channel through the mudflows and is characterized by steep gradients, heavy sediment loads, and in places, a deeply incised channel. Sediment input from glaciers at the headwaters adds to the amount entrained by erosion as the White River cuts through the mudflow and ancient glacial sediments. Estimates of annual sediment transport range from 440,000 to 1,400,000 tons (WDFW et al. 1996). The name "White River" reflects the turbid appearance of the river caused by high levels of suspended glacial sediments during the summer months. There is a visible turbidity gradient at the mouth of the White River as its milky waters join the clearer waters of the Puyallup River. The White River channel, throughout its length, is inherently unstable (WDFW et al.1996). This is the result of a large sediment load, its deposition as the river enters the gentler gradients in the valleys (filling existing channels), and the relative ease of cutting new channels through the remains of the Osceola Mudflow.

The White River Basin receives large amounts of water from heavy precipitation during winter months and from snowmelt in the spring through summer. Because the watershed includes extensive area in excess of 4,000 feet elevation, there is typically a heavy snow pack and occasional rain on snow flood events. Sustained flows are typically highest during May and June and lowest in September and October. Peak flows reached as high as 28,000 cfs before the construction of Mud Mountain Dam (USGS 2013). Given the highly variable flows of the river in response to rainfall and snowmelt and the geologically young, unstable nature of the river channel, it is not surprising that the White River valley has historically been subject to severe floods. The lowermost 9 miles of river flows through urban areas (City of Auburn, WA) and is levied to minimize flood damage.

Mud Mountain Dam and the White River diversion dam are the only man-made dams and reservoirs on the White River. The White River diversion dam is an original feature of the White

River Hydroelectric Project that was completed in 1911, and is currently in poor condition. Puget Sound Power and Light retired the White River Hydroelectric Project in 2004; and conveyed the White River diversion dam, canal and other project works to CWA, a municipal water supply consortium. Mud Mountain Dam, was authorized in 1936. Construction began in 1939 and the Buckley fish trap began operating in 1940, but work was suspended during WWII. The original project was completed and put into operation in 1949.

The operation of MMD significantly modifies the basins seasonal, and sometimes its daily, hydrograph. It does so by storing floodwaters and then slowly releasing the stored water over days or even weeks. It also modifies the daily hydrograph by significantly decreasing flows when water is stored for project work in the reservoir and downstream maintenance of the White River diversion dam.

Puget Sound is a unique and extensive fjord-like system of inland marine and estuarine waters. Its shorelines and watersheds range from highly developed urbanized or industrialized to nearly pristine conditions. Puget Sound has an average depth of 450 feet and a maximum depth of 930 feet. Narrow inlets and shallow sea-floor sills between basins restrict exchange of urbanized waters with relatively cleaner oceanic waters, resulting in a higher concentration of many contaminants, local hot spots, and longer potential exposure times of organisms to urban runoff and emissions.

***Water Quality Standards and Conditions***

The WDOE (WDOE 2012) has designated beneficial uses and associated water quality standards to protect those uses for the White River basin. From the river's mouth to river-mile 4.4, salmon spawning, rearing, and migration are WDOE's designated beneficial uses. From river-mile 4.4 to MMD at river-mile 27.1[9] WDOE has designated the river as core summer salmon habitat and salmonid spawning, rearing, and migration uses. Upstream of MMD the river remains designated as core salmonids spawning, rearing, and migration uses, except where designated for char spawning and rearing, which carries a more stringent set of criteria.

The White River has high pH values that sometimes exceed state water quality standards (WDOE 2013). High pH is caused by high nutrient loads that cause algal growth, removing carbon dioxide from the water thereby raising the pH. This effect is most notable when turbidity is low (generally early fall through early spring) and light penetration facilitates algal growth. The pH can change rapidly during September when turbid summer flows begin to clear and water temperatures remain conducive to rapid algal growth. WDOE (2012a) has identified municipal wastewater treatment facilities at Enumclaw and Buckley, Washington and MIT's White River Fish Hatchery as sources for the river's elevated nutrient (nitrogen and phosphorus) concentrations. This problem was exacerbated by the operation of the White River Hydroelectric Project, which severely reduced flows in the river reach downstream from the White River diversion dam, thereby reducing the river's ability to assimilate nutrients released by downstream wastewater treatment plants. With retirement of this project and the return of near natural flows to the river, the severity of algal blooms and associated high pH conditions have declined.

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[9] WDOE's river-mile designation of the location of MMD differs from the Corps' estimated river-mile location of the dam (RM 29.6).



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Other water quality impairments occur in the White River and a number of tributary streams, mostly in the lower basin, for summer water temperatures and fecal coliform.

Water temperatures in the upper White River (above MMD) sometimes exceed state standards for core salmonid uses. Water temperatures in the White River are warmest in July, August, and September. Average daily temperatures of the White River typically range between 8º C and 11º C in July, while average daily temperatures in August and September typically range from 10 ºC to 11º C.

Turbidity in the White River is influenced by seasonal runoff of silt and glacial flour in the summer months and rain the rest of the year. Glacial flour is colloidal and tends to remain in suspension rather than settling. Runoff from timber harvests also add to the river's turbidity. The MMD project can modify downstream turbidity and suspended sediments, by storing sediment-laden floodwater and subsequently releasing it when flows have subsided, causing sudden increases in bedload and suspended sediment, extending the duration of turbidity events. The White River sometimes exceeds state standards for suspended sediment levels, adversely affecting salmon and steelhead (WDOE 2013).

Supersaturation with atmospheric gas, primarily nitrogen, can occur when water spills over high dams, but this is not a problem for this Project. Mud Mountain Dam does not spill water into a plunge pool that would cause gas super saturation. Water is released via either the 9-foot or the 23-foot tunnels. While MMD has a large, overflow spillway, it has never been used, and would only be used in an unprecedented extreme event.

The average annual flow of the White River near the project is 1,390 cfs (USGS 2013), with monthly average flows ranging from 560 in September to 2,330 cfs in May.

### 2.3.2 Status of Fish Habitat in the Action Area

The complex life cycles exhibited by salmon and steelhead give rise to complex habitat needs, particularly during the freshwater phase (Spence et al. 1996). Spawning gravels must be a certain size and free of sediment to allow successful incubation of the eggs. Eggs also require cool, clean, and well-oxygenated waters for proper development. Juveniles need abundant food sources, including insects, crustaceans, and other small fish. They need places to hide from predators (mostly birds and bigger fish), such as under logs, root wads, and boulders in the stream, as well as beneath overhanging vegetation. They also need places to seek refuge from periodic high flows (side channels and off-channel areas) and from warm summer water temperatures (coldwater springs and deep pools). Returning adults generally do not feed in fresh water, but instead rely on limited energy stores to migrate, mature, and spawn. Like juveniles, they also require cool water and places to rest and hide from predators. They also need migratory corridors with adequate passage conditions (safe passage with respect to barriers, water quality, and water quantity) to allow access to the various habitats required to complete their life cycle.

Mud Mountain Dam is located at RM 29.6. [10] There are no minimum flow requirements for the project, including the 5.3-mile-long reach between MMD and the White River diversion dam.

[10] WDOE's water quality designations (2012) place MMD at river-mile 27.1. This discrepancy is likely due to different cartographers using different threads of the channel to measure. This discrepancy is unimportant to this Opinion and we use Corps river-mile designations to the extent practical.

During normal operations, the project is a run-of-the-river project in which outflows equal inflows. During flood events, the Corps reduces discharge, at times to zero. Following such flood events, the Corps releases stored water at rates in excess of inflow to provide storage for the next event. About 5.5 miles of riverine fish habitat was lost due to construction of the project and its reservoir. Upstream of the project are forested lands and the alpine slopes of Mt. Rainier. Outside of Mt. Rainier National Park and U.S. Forest Service managed wilderness, much of the upper White River watershed is managed for timber production on both Federal and private lands. Anadromous fish habitat tends to be best in accessible wilderness and park stream reaches.

Immediately downstream from the project, the river runs for 5.3 miles through a steep, undeveloped canyon. White River diversion dam blocks adult anadromous fish access to this river reach. This river reach is only accessible to juvenile anadromous fish that migrate from higher in the basin and occasional adults that successfully pass the diversion dam or fall back after being released upstream of MMD.

At the White River diversion dam, the river runs between the small towns of Buckley and Enumclaw, WA, but remains mostly rural. The downstream river reach is heavily used by PS Chinook salmon and PS steelhead for spawning and rearing. At RM 10, the river enters the city of Auburn, WA which is heavily urbanized and the river's meanderings are constrained by levees for much of its remaining length.

The MMD Project affects anadromous fish access to the river upstream of the White River diversion dam and habitat characteristics in the lowermost 24.3 miles of the White River.

The MMD Project primarily affects the following habitat components that influence PCEs in the lower 24.3 miles of the White River:

- Coarse sediment supply
- Large woody debris (LWD) supply
- Instream flows
- Riparian vegetation
- Floodplain connectivity
- Aquatic productivity

***Coarse Sediment Supply (PCE 1*)**

Mud Mountain Dam reservoir retains some of the bedload material derived from the upper White River and its tributaries. Although the dam clearly disrupts bedload transport from areas upstream of the project to areas downstream from the project, large amounts of bedload are passed downstream into the river each year through the 9-foot tunnel. Coarse sediment is important to PS Chinook salmon and PS steelhead because it is needed for spawning.

Although the project modifies the White River's sediment budget, spawning gravels are abundant both upstream and downstream from the project (Judge 2011).

***LWD Supply and Riparian Conditions (PCE 2)***

Mud Mountain Dam blocks the transport of LWD from upstream locations. LWD is important to PS Chinook salmon and PS steelhead because it provides velocity and hiding shelter to juvenile salmonids. The Corps stockpiles LWD that enters the reservoir during high flow events. Pieces that meet LWD criteria are set aside and made available for habitat improvement projects.

***Instream Flows (PCEs 1, 2, 3, 4)***

Mud Mountain Dam is operated as a single-purpose, flood control project. The objective of the Corps' flow manipulation is to reduce downstream flood damage by storing floodwater on a seasonal or daily basis and then releasing it later after the risk of downstream flood damage subsides. However, flow manipulations can have adverse and beneficial effects on fish and other aquatic life. The types of adverse effects to fish from fluctuating flows downstream of dams were described by (Hunter 1992):

- Changes in the amount of habitat
- Stranding, especially of fry and juveniles
- Increased juvenile emigration
- Increased predation
- Desiccation of eggs
- Decreased abundance and diversity of macroinvertebrates
- Interruption of spawning

White River flows are modified by two actions in the watershed: episodic flood control operations at MMD; and, water diversion at the White River diversion dam. Flows downstream from the White River diversion dam have increased substantially since the Puget Sound Energy retired its White River Hydroelectric Project in 2004, which routinely diverted up to 2,000 cfs for project operation, at times severely dewatering the river downstream. While the diversion capacity and state-issued water rights continue to allow up to a 1,000 cfs diversion rate, CWA has adopted a protective minimum flow schedule (Table 3) and following annual refill of Tapps Lake, diverts only enough water to meet domestic water supply needs, typically about 100 cfs.

**Table 3. White River minimum flows adopted by CWA and mean monthly discharge at USGS Station No. 12099200 (White River above Boise Creek at Buckley, WA)**

| Time Period | Minimum Flow | Mean Monthly Discharge | Time Period | Minimum Flow | Mean Monthly Discharge |
|---|---|---|---|---|---|
| **Jan 1-14** | 650 | 2,120 | Jul 1-24 | 800 | 1,370 |
| **Jan 15-31** | 525 | | Jul 24-31 | 650 | |
| **Feb 1-14** | 550 | 1,260 | Aug 1-6 | 650 | 787 |
| **Feb 15-29** | 500 | | Aug 7-31 | 500 | |
| **Mar 1-14** | 550 | 1,140 | Sep 1-14 | 500 | 560 |
| **Mar 15-31** | 725 | | Sep 15-30 | 500 | |
| **Apr 1-14** | 775 | 1,430 | Oct 1-14 | 500 | 611 |
| **Apr 15-30** | 825 | | Oct 15-31 | 500 | |
| **May 1-14** | 875 | 2,330 | Nov 1-14 | 500 | 1,400 |
| **May 15-31** | 875 | | Nov 15-30 | 550 | |
| **Jun 1-14** | 800 | 2,270 | Dec 1-14 | 550 | 1,350 |
| **Jun 15-30** | 800 | | Dec 15-31 | 600 | |

Salmonid habitat derives benefits and losses associated with managing peak flows. For example, salmon survival from egg to fry is inversely related to the magnitude of peak flows during incubation (Zimmerman et.al 2010). This effect is associated with bed scour in which high flows mobilize streambed elements, exposing and dislodging eggs. On the other hand, periodic bedload movement, similarly associated with high stream flows, can improve future spawning habitat conditions by reducing embeddedness [11] and imbrication of the substrate, thereby facilitating future redd construction.

To reduce downstream flood damage, the dam stores floodwater during periods of high runoff that otherwise would scour the eggs, alevins, and fry of PS Chinook salmon, and reduces mortality from an otherwise natural and normal environmental effect. This action can result in improvements of egg to fry survival if relationships examined on the Skagit River are true for similar conditions in the White River (Kinsel et al. 2008, Zimmerman et al 2010). Kinsel et al. (2008) showed that Chinook salmon egg to fry survival in the Skagit River is negatively related to flood recurrence interval for flows greater than a 2-year event. During years in which Skagit River peak flows did not exceed the 2-year recurrence interval flood, egg survival ranges from about 10 % to 17 % and appears unrelated to flow. Due to biogeographical similarity to the

[11] Embeddedness is the degree that the larger substrate particles (e.g., boulder, rubble, gravel) are surrounded or covered by fine sediment. Embeddedness can make redd construction more difficult and reduces intergravel flow, decreasing incubation success.



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Skagit watershed, we believe that the reduction in peak flows greater than the 2-yr recurrence interval flood on the White River would have beneficial effects on Chinook salmon egg to fry survival. Poor egg-to-outmigrant survival because of peak flow events is a major factor limiting Chinook salmon production in Puget Sound rivers (WDFW 2008). The flood control operation of MMD substantially reduces the magnitude of peak flow events in the White River downstream from MMD. The volume of flood storage reduces peak flows, and the Corps attempts to prevent flows from exceeding 8,000 or 9,000 cfs downstream of the project in the White River and 50,000 cfs in the Puyallup River. This has benefitted Chinook salmon eggs incubating in the affected reach by minimizing redd scour. There is no beneficial flood control effect upstream of MMD, which is where most natural spawning by Chinook salmon occurs.

It is common for MMD to release water stored during a flood event as soon as the downstream flood risk declines. As a result, sediments that are stored along with the water may be released when the river does not have the energy needed to keep the sediments moving. These sediments may settle in spawning and rearing areas, reducing reproductive success. Managed flows from MMD cause both beneficial and detrimental effects to fish life in the lower White River. There are no data from which to determine if the negative effects are offset by reduced redd scour from flooding that would otherwise occur.

The White River diversion dam requires frequent repairs due to flood damage, requiring flows from MMD to be reduced to 350 cfs or less. Prior to 2005, these repair events were not coordinated with NMFS and the required flow reduction sometimes led to entrapment and stranding of juvenile salmonids. [12] In 2005, the Corps, NMFS, USFWS, and WDFW developed a more protective protocol, reducing the potential for entrapment and stranding. In a separate agreement, CWA, the current owners of the White River diversion dam, agreed to coordinate such repairs with Federal, state, and tribal parties (Corps 2013a, Appendix C). However, the need for these periodic repairs continues and while the adverse effects have been reduced, the repairs continue to require flow reductions that have the potential to entrap and strand juvenile fish in the 29.6-mile downstream river reach.

***Floodplain Connectivity (PCE2)***

A watershed's flow regime is an important component of the channel's morphology and riparian conditions. Small and moderate-sized stream discharges (less than or equal to flows with a 2-year recurrence interval) are generally contained within the channel, while larger discharges that occur less frequently exceed the channel capacity and overflow onto the floodplain. During floods, water is stored in sloughs and side channels, or seeps into floodplain soils recharging groundwater storage. This stored groundwater slowly drains back to the channel, providing a source of cool inflow during the summer (Naiman et al. 1992). Since larger floods are stored at MMD and released later as lower flows, only the sloughs and side channels on the lower river terrace floodplain are recharged.

Side channels to the White River provide important habitats to rearing PS Chinook salmon and steelhead. Both Chinook salmon and steelhead typically spawn in the main channel, but rearing juveniles make extensive use of shallower and slower velocity side channels.

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[12] On April 9, 2003, the Corps, at Puget Sound Energy's request, held water at MMD and reduced streamflow downstream and in the White River hydro project bypass reach (RM 2 – RM 23) causing a major fish kill. Since the 2003 fish kill, the Corps coordinates flow reductions with NMFS and other agency and tribal stakeholders.

Flood control operations at MMD (the primary project purpose) have reduced the formation and quality of off-channel and side-channel habitat within the floodplain. Periodic storage of floodwaters limits the magnitude of once ordinary floods. This flow control has resulted in less and lower quality side- and off-channel habitat in the existing environment.

***Aquatic Productivity (PCE 2)***
Relatively little information is available regarding the production of periphyton and benthic macroinvertebrates (BMI) in the White River sub-basin. However, the recent explosion in the population of pink salmon in the basin provides up to 2,000 tons of marine-derived nutrients to the White River during odd-numbered years when up to 800,000 fish return to the White River. Thus, in recent years, aquatic productivity has increased substantially.

***Spawning Habitat (PCE 1)***
Spawning habitat conditions for PS Chinook salmon and PS steelhead in the White River sub-basin range from poor to good, depending on location. Sufficient quantities of suitably sized substrate are not lacking, but the quality is poor in some areas as a result of fine sediment originating from natural glacial sources and from forest land use practices. Steelhead spawning areas substantially overlap those of Chinook salmon, but include more extensive use of tributaries. The project effectively removes the 5.5 miles of river between MMD and the diversion dam from any meaningful spawning use, but the habitat loss is moderate because the high stream gradient limits the amount of productive spawning habitat therein.

***Rearing Habitat (PCE 2)***
Juvenile PS Chinook salmon and PS steelhead rear throughout the lower White River and Boise Creek, as well as in the upper river and its tributaries, extending downstream of the major spawning areas. Rearing juveniles have been observed all the way down to the confluence of the White and Puyallup Rivers. Judge (2011) identified a number of limiting factors within the Puyallup/White River basin that could affect the quality and quantity of fry and juvenile rearing habitat: degraded riparian zones, dam operations, sedimentation and mass wasting, high water temperature, hydromodification, and loss and reduced connectivity of estuarine habitat. As a general trend, degradation and loss of rearing habitat is highest in the estuary region and gradually improves in an upstream direction as the number and severity of the limiting factors decline.

***Migration Corridors (PCE 3)***
With the exception of about 5 miles of spawning habitat periodically inundated by the MMD reservoir and at the 5.5 mile reach from MMD downstream to the White River diversion dam, Chinook salmon and steelhead have access to nearly all of the historical spawning areas available in the sub-basin. However, the condition of migration corridors is impaired by the existence, operation, and maintenance of MMD, the White River diversion dam and outdated fish passage facilities.

Mud Mountain Dam is an obstacle to upstream and downstream fish migration. The Corps addressed upstream migration in 1948 with an agreement with PSE (Puget Sound Power & Light at the time). Puget Sound Energy had a water diversion dam at Buckley for its White River

Hydroelectric project with a small fish ladder to pass upstream migrating fish. The Corps modified the left bank of the dam to include a fish ladder leading to a trap-and-haul facility that it operates by trapping and brailing upstream migrating fish into a tank truck equipped to transport fish.

***Adult Passage - Trap and Haul System***
The only way for returning PS Chinook salmon and PS steelhead to reach spawning and rearing habitat upstream of MMD is by way of the Corps' trap and haul system. The trap is located along the left abutment of the White River diversion dam. The dam serves as a fish passage barrier and, by arranging flashboards at the dam crest, provides attraction flows that encourage returning adults toward the fishway and trap. From the trap entrance, fish navigate a series of weirs to the entrance of a holding pool. Fish enter the holding pool via a narrow V -shaped slot between wooden slats. Fish caught in the trap are contained within a brail basket (commonly called the "floor"), also composed of wooden slats. In trap operation, the basket is raised slowly and fish are crowded from the holding pool into a steel hopper approximately 64 feet square. When large numbers of fish prevent sorting, or when sorting is not needed for fish management, the hopper can be raised and evacuated directly into the fish transport truck via a sealed coupling. Thus, fish can remain in the water during the entire capture and transport operation. The transport trucks are outfitted with oxygen monitoring and automated controls set to maintain the dissolved oxygen levels with a target of 12 mg/g but no less than five mg/g. Transport is conducted within a total time span of about 0.5 to 2 hours, so water temperatures in the truck do not significantly change during transport. The longest that a fish may remain in the trap is three days, though the trap may be checked and fish transported multiple times daily during the peak of adult migration. At the release site, fish are returned to the river via a flume. The drop to the river is minimized and typically does not exceed 4 feet. The release process does not require handling the fish or removing them from the water.

When necessary for fish management purposes, trapped fish may be sorted. Sorting hatchery origin returners from natural origin returners is performed manually, using dip nets, and is facilitated by identifying fin clips, or coded wire tags placed on the fish as juveniles prior to release from the hatchery. In most years half or more of the hatchery Chinook salmon are captured at the fish trap and transported to the hatchery. The remaining hatchery-origin returning adults are transported to the release site upstream of MMD where they contribute to the spawning population. Other salmon, wild steelhead, and bull trout are also transported to the fish release site. Many transported fish are handled to facilitate such sorting. Because the hatchery and wild Chinook salmon should be sorted and since the bull trout are often co-mingled with the Chinook salmon in the trap, both are routinely dip-netted by MIT and WDFW personnel and handed to the Corps operator sitting on top of the truck. The Corps operator then gently releases the fish into the truck. Also, PTI biologists often dip-net fish to take scale samples prior to placing them into the truck.
Returning White River Chinook salmon adults enter freshwater and begin arriving at the diversion dam for passage around MMD in May and continue through October (PTF 2006). White River diversion dam flashboards are set to try to attract upstream migrants to the left bank fish ladder leading to the Corps' trap, and to a lesser extent, the right bank fish ladder that leads to the Muckleshoot fish hatchery. The dam apron is made of wood and some of the timbers are rotted or broken away with many exposed spikes and rebar. Adult Chinook salmon can, and do,

become trapped or stranded in these voids, at least temporarily, resulting in delay, injury and death in some cases, according to Puyallup Tribal staff who work with the Corps at the trap (PTF 2013). Additionally, some fish injure or kill themselves by jumping against the exposed rebar and broken timbers of the dam apron. A major contributing factor to impaired passage is the recent explosion in the abundance of pink salmon (*O. gorbushca*). Prior to decommissioning the White River Hydroelectric Project in 2004, few if any pink salmon entered the White River. Following decommissioning and the resulting return of near-natural flows to the White River, the population has grown exponentially, with estimated escapement of around 800,000 adult pink salmon in 2013. Pink salmon runs show an alternating biannual pattern with high numbers of returning adults during odd numbered years and small numbers returning during even numbered years. Although large pink salmon runs complicate the process of upstream fish passage around MMD, the recent dramatic increase in the biannual pink salmon run benefits the White River ecosystem. Recent runs add about 2,000 tons of marine derived nutrients to the sub-basin that otherwise would not occur, likely improving the growth and survival of rearing juvenile salmonids. Bull trout in particular, along with juvenile coho and steelhead benefit from this massive input of food and nutrient value in the form of salmon eggs and decomposing pink salmon carcasses. However, recent research suggests that Chinook salmon juveniles that emigrate from freshwater concurrently with young-of-the-year pink salmon survive at lower rates than those that do not outmigrate concurrently with pinks, suggesting that juvenile pink salmon compete with juvenile Chinook salmon for food (Ruggerone and Goetz 2004).

The number of injured fish and subsequent mortalities are not fully known, but Chinook salmon with head lesions have ranged from 10 to 20%, and about 40% of the fish hauled upstream of MMD are not accounted for in spawning surveys (PTF 2013), indicating a high rate of pre-spawning mortality. Injuries occur even when the number of fish in the trap is relatively low and there are few pink salmon present, however, injuries become more prevalent when large numbers of fish are present, particularly in odd numbered years when very large numbers of pink salmon are present. The sheer numbers of fish overwhelms the capacity of the fish ladder, brail, and trap even when it runs 24 hours/day for several weeks, resulting in passage delay and large aggregations of fish at the dam and trap, attempting to ascend the river. A significant number of fish are injured or killed trying to locate the fish ladder, and during brail and trap operations (Ladley 2014). The Corps maintains the trap is in good working order and smoothed the transition from the brail to the trap in 2013 to reduce one known cause of injury. However, the trap and brail system continues to cause injury and death. Other problems are caused by the poorly functioning trap in addition to the injury to the fish. During the period of Chinook salmon and pink salmon returns overlap, the Corps has been unable to sort hatchery Chinook salmon from wild, or even accurately census them. Therefore, the MIT has been unable to collect enough Chinook salmon spawners to meet its broodstock goal in some years. Lack of a safe and effective fishway facility has caused injury, mortality, and reduced broodstock collection, constraining survival and recovery.

Delay caused by inadequate capacity of the trap and haul system increases the duration of adult salmon exposure to causes of injury and mortality at the diversion dam. Caudill et al. (2007), researching the effects of passage delay on Columbia River Chinook salmon, showed that fish that were delayed during dam passage were less likely to reach their natal spawning grounds. Fish delayed at the White River diversion dam may continue to try to ascend the river, leading to



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headburn [13] and other injuries. Large numbers of PS Chinook salmon, delayed at the diversion dam have been observed in Boise Creek, a very small tributary that enters the White River about one mile downstream from the diversion dam. This small tributary provides suitable spawning habitat for about 50 Chinook salmon. Puyallup tribal biologists counted over 500 adult Chinook salmon crowded into the 4.5 miles of Boise Creek accessible to spawning fish during the large pink salmon run of 2011. This suggests that excessive competition for spawning locations and substantial redd superimposition occurred, greatly reducing spawning success. Crowding also increases the rate of disease infectivity. Losses attributable to the existing dam and trap include direct mortalities at the diversion dam from hitting against the dam for an extended period of time, sub-lethal injuries that increase a fish's susceptibility to subsequent infection by pathogens, excessive stress, reduced vigor, and straying.

Chinook salmon are sorted at the trap during normal operations to return marked hatchery Chinook salmon to the Muckleshoot hatchery and haul unmarked natural origin Chinook salmon for release upstream of MMD. When pink salmon return in large numbers, the Corps discontinues sorting Chinook salmon because there are too many fish to handle. In 2011 this resulted in the hatchery not receiving the necessary number of marked hatchery origin Chinook salmon to meet its brood stock goal, and hatchery Chinook salmon were hauled upstream along with NOR Chinook and pink salmon. Sorting hatchery Chinook salmon from NORs is a necessary procedure to meet ESA genetic criteria where hatchery and natural origin fish occur in the same river system. Among the Chinook salmon transferred to the Muckleshoot hatchery, up to 20% die before they can be spawned, generally due to fungus development around head injuries of the type that result at the diversion dam and in the fish trap facility (MIT 2013). The overlap in Chinook salmon and pink salmon run timing is not complete. Half or more of the Chinook salmon arrive at the Buckley trap and are transported to the hatchery or upriver before the pink salmon appear in numbers large enough to force Chinook salmon sorting to be discontinued. Chinook salmon can also be delayed when large over-lapping coho runs occur as well. Steelhead run timing does not overlap other species significantly, and delayed transport has not been reported as a fish passage problem.

The White River diversion dam functions as a part of the Corps' upstream fish passage system. The Corps first entered into an agreement with PSE, which formerly owned the White River diversion dam, to purchase a small piece of land, where it developed its trap-and-haul fishway, and to use the diversion dam to direct upstream migrating fish into the fish ladder leading to the trap-and-haul facility. The fishway depends on the operational function of the White River diversion dam to perform its intended purpose.

The Corps' Buckley fishway and trap-and-haul facility is aged and functionally obsolete. The trap was the second of its kind, has been in operation since 1941 (Corps 2013a), and was not designed or constructed to facilitate the sorting of fish. Sorting fish is a recent need and action made necessary by changes in fish management requirements, including the listing of PS Chinook salmon and PS steelhead as threatened under the ESA, and the resulting need for conservation and recovery measures. The fish trap is still functioning but is not safe or effective,

[13] Headburn lesions are primarily caused when fish collide with concrete or other structures at dams and other fish passage facilities. Such injuries render affected fish more susceptible to fungal and bacterial infections.



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and requires a high level of fish handling, causing stress, injury and mortality to returning adults of both PS Chinook salmon and PS steelhead.

Fish trapped and loaded into the fish-hauling tank, trucks used by the Corps, can spend up to two hours in the tank prior to release at the upstream off-loading site, increasing the stress of crowding. The tank truck backs up to a release chute located alongside the upper White River. The tank gate is opened, and fish slide down the chute with the load of water into the river.

The White River runs extremely turbid during the summer months, with the visible depth often less than six inches. Even with poor visibility conditions, Muckleshoot Tribal staff has observed dozens of dead pink salmon immediately downstream of the Corps' trap-and-haul fish release site upstream of MMD (MIT 2013). We expect that some Chinook salmon subjected to these same actions and conditions are among the dead salmon even if not directly observed, because Chinook are intermingled with the pink salmon as they move upstream and experience the same hazards at the diversion dam.

In summary, the existing adult salmon passage system presents the following hazards:

1. Injury or death at the dilapidated dam apron,
2. Injury or death in the inadequate trap,
3. Injury or death from delayed passage due to insufficient capacity of the trap and haul system, increasing exposure to the hazards at the dam apron, disease, stress, and straying, and
4. Reduced ability to sort fish due to crowding, frustrating fulfillment of current fish management goals, including maintaining the genetic integrity of the wild stock.

As a result of these hazards, fewer listed PS Chinook salmon and PS steelhead have been able to make use of high quality spawning and rearing habitats upstream of MMD.

***Juvenile Passage***

Downstream migrating juvenile anadromous fish must pass through MMD and over the White River diversion dam. Both present hazards and reduce juvenile passage survival.

The entire flow of the White River passes through MMD via one of two tunnels, a horseshoe-shaped 9-foot tunnel with an invert elevation of 895 feet msl, or the 23-foot diameter circular tunnel with an invert elevation of 910.5 feet msl. The hydraulic control mechanism of the tunnels was modified by the Corps in 1995. The Corps converted control structures located at the outlets (Howell-Bunger valves) to intake controls with radial gates operated from a control tower in the forebay. The replaced downstream control mechanism included a Howell-Bunger type energy dissipation valve, a type which generally causes a very high mortality rate to fish passing through it. The Corps designed the modifications to reduce or eliminate passage through MMD as a source of fish mortality. However, no specific monitoring had occurred prior to the initial ESA section 7 consultation in 2007 to verify the improvement, so the Incidental Take Statement in NMFS biological opinion (NMFS 2007a) required the Corps to coordinate a downstream passage study with NMFS so that passage success could be evaluated and modifications made if needed.

In 2011 and 2012, the Corps conducted studies at MMD with acoustically tagged steelhead smolts (R2 Resources 2013, Corps 2013c) to evaluate downstream passage through the 23 foot tunnel (2011), and through the 9' tunnel (2012). The 2011 study evaluated test and control group releases of 30 smolts each upstream and downstream of Mud Mountain Dam, using the 23-foot tunnel only. Downstream detections by acoustical receivers were approximately equal, with 12 test group smolts released upstream of the dam into the 23-foot tunnel detected and 11 control group smolts released downstream of the dam detected. [14] The 2012 study evaluated passage through the 9-foot tunnel. In that study, 17 of the 30 control group tags were detected downstream, but only 3 of the test group tags were detected, indicating low (~18%) survival through the 9-foot tunnel. River flows of 2,500 cfs exceeded the 2,000 cfs open-flow capacity of the 9-foot tunnel during the 2012 test, which may have affected passage survival. This study indicates a low level of survival through the 9-foot tunnel that deserves additional investigation.

Once past MMD, outmigrating juveniles must pass over the White River diversion dam near Buckley, WA. Water passing over the low diversion dam has no plunge pool and falls directly onto a derelict wooden apron. Effects of such passage has not been documented or quantified but likely vary depending on where they pass over the weir. Experience at other dams in the region suggests that passing the diversion dam has only a small effect on juvenile survival. Since migrants tend to follow the heaviest flow, and that flow goes through the notches in the flashboards along the river's left (south) bank, we assume that most smolts pass the diversion dam through the flashboard notches and spend very little time in the vicinity of the dam.

Some downstream migrants encounter the water diversion along the river's left bank, immediately upstream of the diversion dam, operated by the CWA. Because the amount of water diverted is small relative to the river flow, the proportion of smolts encountering the diversion would also be small. Cascade Water Alliance's diversion flume is equipped with a fish screen and bypass that was designed in collaboration with NMFS to minimize impingement and entrainment when the diversion served the now defunct White River Hydroelectric Project. Survival of fish bypassed at the screen was high in tests conducted when it was owned and operated by PSE. We believe survival remains high because conditions are not known to have changed.

***Artificial Propagation***

Currently, three hatcheries produce White River Chinook salmon with the goal of supplementing the population and preventing extirpation: WDFW's Minter and Hupp Springs hatcheries and MIT's White River hatchery. Both the state and tribal hatchery programs are managed to support survival and recovery of the White River Chinook salmon population. Minter and Hupp Springs hatcheries are very close and operated in a coordinated fashion for Washington's White River spring-run Chinook salmon program. The program aims to collect 540 adults from hatchery returns (a portion of smolts are released at Minter Creek to support subsequent broodstock collection), with a production target of 250,000 sub-yearlings and 85,000 yearlings. This

[14] It is not unusual for test fish to be lost to a study for reasons other than the treatment being tested. Fish may be killed by the tag itself, may not migrate after release, or be consumed by predators. For that reason, a control group is simultaneously released without experiencing the treatment being tested – in this case, passage through MMD and comparisons are made between the treatment group's detections at downstream monitoring points and the control group's detections at the same monitoring points to determine the effects of the treatment.

program is funded with state of Washington general fund monies. The Muckleshoot Indian Tribe opened its White River hatchery on the right (north) bank of the river at the White River diversion dam in 1989, in part to assist in preserving and restoring the native White River spring-run Chinook salmon (WDFW 1996). The hatchery produces about 90,000 yearling and 200,000 sub-yearling Chinook annually and provides 200,000 to 300,000 Chinook fingerlings to acclimation ponds located on tributaries of the Greenwater River and Huckleberry Creek in the White River headwaters upstream of MMD. The Bureau of Indian Affairs and Muckleshoot Tribe fund the spring Chinook salmon propagation program at the White River hatchery.

The White River hatchery is operated by the Muckleshoot Tribe incorporating the guidelines and recommendations of the HSRG (HSRG 2003). This includes using NOR in the hatchery broodstock. The NORs are wild and unmarked spring Chinook salmon that must be sorted and separated from both other fish species and from other Chinook salmon that return to the Corps' fish trap. The HSRG management objective is to use broodstock at the hatchery consisting of between 10 and 20% NORs, but not to exceed 10% of the total NOR return. Although there are adverse effects from hatcheries related to both Chinook and steelhead (NMFS 2014), this is an important program for survival and recovery of the White River population of PS Chinook salmon.

Returns of hatchery origin adults have averaged around 600 spring Chinook, 566 from the acclimation pond operations, and 32 from natural reproduction in the White River sub-basin. The Tribe also began culturing native White River steelhead in 2007 in response to declining adult returns. This smaller operation rears up to 30,000 juvenile steelhead smolts each year.

### 2.3.3 Status of Southern Resident Killer Whale Habitat in the Action Area

In our listing decision for SR killer whales we identified three main threats to their survival: 1) scarcity of prey, 2) high levels of contaminants from pollution, and 3) disturbance from vessels and sound. As of the end of 2010 there were only 86 whales in this small population. Their small population size and social structure also put them at risk for a catastrophic event, such as an oil spill, that could impact the entire population.

#### *2.3.3.1 Prey Availability*

When prey is scarce, whales likely spend more time foraging than when it is plentiful. Increased energy expenditure and prey limitation can cause nutritional stress. Nutritional stress is the condition of being unable to acquire adequate energy and nutrients from prey resources and as a chronic condition can lead to reduced body size and condition of individuals and lower birth and survival rates of a population. Ford *et al.* reported correlated declines in both the Southern Resident killer whales and Chinook salmon and suggested the potential for nutritional stress in the whales (Ford *et al.* 2005, Ford *et al.* 2010). Food scarcity could also cause whales to draw on fat stores, mobilizing contaminants stored in their fat and potentially have the ability to alter thyroid homeostasis, reduce immune function, cause neurotoxicity, reproductive failure, and restrict the development and growth of the individual (see Table 9 in NMFS 2008 for a review of physiological effects resulting from exposure to toxic chemicals in marine mammals). Thus, nutritional stress may act synergistically with high contaminant burdens in the whales and result in contaminant-induced adverse health effects, higher mortality rates, or lower birth rates.



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The availability of Chinook salmon to SR killer whales is affected by a number of natural and human actions. The most notable human activities that cause adverse effects include land use activities that result in habitat loss and degradation, hatchery practices, overharvest, and hydropower systems. Details regarding baseline conditions of Puget Sound Chinook salmon in inland waters that are listed under the Endangered Species Act are described above.

Here we provide a review of Southern Resident killer whale determinations in previous ESA Section 7(a)(2) consultations where effects occurred in the action area, and where effects resulted in a significant reduction in available prey ( i.e., where prey reduction was likely to adversely affect or jeopardize the continued existence of the whales). We also consider activities that have impacts in the action area, and are out of our jurisdiction for Section 7(a)(2) consultation, but nonetheless significantly reduce available prey (e.g., salmon harvest in Canada). We then assess the remaining prey available to Southern Resident killer whales in light of this environmental baseline.

Habitat-altering activities such as agriculture, forestry, marine construction, levy maintenance, shoreline armoring, dredging, hydropower operations and new development can reduce prey available to SR killer whales.. Since the SR killer whales were listed, federal agencies have also consulted on the likely impacts of their actions on SR killer whales, including impacts to available prey. In addition, the environmental baseline is influence by many actions that pre-date the salmonid listings and that have substantially degraded salmon habitat and lowered natural production of Puget Sound Chinook salmon.

There are also hatchery programs that create prey available to Southern Resident killer whales and can affect their long-term viability of salmon populations. ESA consultations on these programs in the action area have not been completed to date, but a process for doing so is currently under development. The magnitude of change in prey available because of these habitat, hydropower and hatchery activities in the action area are not explicitly summarized here; however, our estimates of prey available to SR killer whales in light of the environmental baseline are based on a fishery harvest management model (described further below). The model is used to estimate abundance of fish in the ocean, and is based on catch and escapement data. These data should reflect all baseline and natural mortality sources, because fish lost to other activities would not be accounted for in escapement or catch data, and thus not represented in the abundance estimates.

We have previously consulted on the effects of flood insurance on Southern Residents. NMFS' biological opinion on the National Flood Insurance Program in Washington State-Puget Sound region concluded that the action was likely to jeopardize the continued existence of the Puget Sound Chinook salmon ESU, and that the potential extinction of this ESU as a long-term continued existence of Southern Residents (NMFS 2008a).

We have previously consulted on the effects of salmon harvest on Southern Residents. NMFS conducted annual consultations to evaluate effects on Southern Residents of Pacific Coast Salmon Plan fisheries managed by the PFMC (2006-2007, 2007-2008 and 2008-2009, i.e., NMFS 2008b, NMFS 2009) and the U.S. Fraser Panel fisheries (2007, 2008, and 2009, i.e., NMFS 2008c). In 2009, NMFS consulted on a range of Pacific Coast Salmon Plan harvest scenarios based on past-authorized harvest levels and salmon stock abundances. While past consultation on these fisheries had been for a single year, the 2009 consultation was for an undefined duration (NMFS 2009). In 2008 we consulted on the effects on Southern Residents of northern U.S. and Canadian fisheries, and general obligations of southern U.S. fisheries (further constrained by other harvest actions and subject to separate section 7 consultations) under the Pacific Salmon Treaty agreement (new fishing regimes, i.e., amended Chapters 1, 2, 3, 5, and 6 of Annex IV of the Treaty, 2009-2018, NMFS 2008d). In 2010, we consulted on effects of programs administered by the Bureau of Indian Affairs that support Puget Sound tribal salmon fisheries and salmon fishing activities authorized by the U.S. Fish and Wildlife Service in Puget Sound as well as fisheries authorized by the U.S. Fraser Panel in Puget Sound (from May1, 2010 to April 30, 2011, NMFS 2010b and c).

In past harvest opinions, we characterized the short-term and long-term effects on SR killer whales from prey reduction caused by harvest. We considered the short-term direct effects to whales resulting from reductions in Chinook salmon abundance that occur during a specified year, and the long-term indirect effects to whales that could result if harvest affected viability of the salmon stock over time by decreasing the number of fish that escape to spawn. These past analyses suggested that in the short term prey reductions were small relative to remaining prey available to the whales. In the long term, harvest actions have met the conservation objectives of harvested stocks, were not likely to appreciably reduce the survival or recovery of listed Chinook, and were therefore not likely to jeopardize the continued existence of listed Chinook. The harvest biological opinions referenced above concluded that the harvest actions cause prey reductions in a given year, but were not likely to jeopardize the continued existence of ESA-listed Chinook salmon or SR killer whales.

#### *2.3.3.2 Contaminants*

Because Southern Resident killer whales feed in close proximity to industrial and agricultural areas where exposure to contaminants can be relatively high, live a long time, and are at the top of the food chain, they are a relatively highly contaminated population of whales. Recent studies have documented high concentrations of PCBs, DDTs, and PBDEs in killer whales (Krahn et al. 2004, Reijnders and Aguilar 2002, Ross et al. 2000; Ylitalo et al. 2001, Krahn et al. 2007, Krahn et al. 2009). Harmful contaminants are stored in blubber, and can later be released and become redistributed to other tissues when the whales metabolize the blubber in response to food shortages or reduced acquisition of food energy that could occur for a variety of other reasons (i.e., disease or reduced foraging efficiency from vessel disturbance). Once these pollutants enter into a whale's circulation they have the potential to affect the whale's immune system and reproductive fitness (Krahn et al. 2002). Although it is currently unknown what role contaminants play in the status of the Southern Resident killer whales, and caution must be used when extrapolating risks across species (Schwacke et al. 2002), Southern Resident killer whales have body burdens that are above health effects thresholds found in other marine mammals (e.g., Hall et al. 2003, Krahn et al. 2007, Krahn et al. 2009), suggesting the whales may already have contaminant levels that can cause deleterious biological health effects.

Puget Sound is a deep-water, multi-branched fjord with several sills that restrict mixing and inhibit ocean inflow and the outflow of toxic chemicals. Toxic chemicals that enter the basin have longer residence times within the basin resulting in food webs being exposed to higher levels of persistent pollutants. Additionally, many species are known to exhibit a high degree of residency within Puget Sound (e.g., there are several resident populations of fish including Pacific herring and Chinook salmon) resulting in more fish being exposed to more contaminants. Thus, the Puget Sound ecosystem and food webs are more susceptible to toxic input because of the proximity to urban areas, and the combination of hydrological isolation of the Puget Sound and the biological isolation of resident species (Collier et al. 2006; West et al. 2008; O'Neill and West 2009). For example, Chinook salmon that remain as residents and mature in Puget Sound experience a three-to five-fold exposure to some contaminants compared to others that migrate and grow to adulthood in the Pacific Ocean (O'Neill and West 2009). Chinook salmon contain higher levels of some contaminants than other salmon species, but only limited information is available for contaminant levels of Chinook salmon in Puget Sound (i.e., Krahn et al. 2007, O'Neill and West 2009, Veldhoen et al. 2010).

#### *2.3.3.3 Vessel Activities and Sound*

Vessels used for a variety of purposes (commercial shipping, military, recreation, fishing, whale watching and public transportation) occur in inland waters of the SR killer whales' range. Several studies in inland waters of Washington State and British Columbia have linked interactions of vessels and Northern and Southern Resident killer whales with short-term behavioral changes (Kruse 1991; Williams et al. 2002a, 2002b; Foote et al. 2004; Bain et al.2006; Noren et al. 2009a; Noren et al. 2009b, Holt 2008, Holt et al. 2009, Noren et al. 2010). These vessel activities may affect foraging efficiency, communication, and/or energy expenditure through the physical presence of the vessels, underwater sound created by the vessels, or both. Collisions of killer whales with vessels are rare, but remain a potential source of serious injury and mortality.

Commercial sonar systems designed for fish finding, depth sounding, and sub-bottom profiling are widely used on recreational and commercial vessels and are often characterized by high operating frequencies, low power, narrow beam patterns, and short pulse length (NRC 2003). Frequencies fall between 1 and 500 kHz, which is within the hearing range of some marine mammals including killer whales and may have masking effects (i.e., sound that precludes the ability to detect and transmit biological signals used for communication and foraging).

In inland waters, the majority of vessels in close proximity to the whales are commercial and recreational whale watching vessels and the average number of boats accompanying whales can be great during the summer months (i.e., from 1998 to 2006 an average of 18 to 22 boats were within ½ mile in inland waters from May to September; Koski 2007). Sound generated from whale watch vessels varies by vessel size, engine type, and operating speed (Holt 2008). A few studies have evaluated the consequences of short-term behavioral responses on the health of the cetacean populations (i.e., Williams et al. 2006, Noren et al. 2009b, Holt et al. 2009, and Lusseau et al. 2009). Likely effects of vessel interaction and noise include increased energy expenditure from behavioral responses and decreased foraging efficiency due to masking. Both of these effects, particularly in combination, may reduce killer whale fitness. NMFS recently issued vessel management regulations to protect SR killer whales from vessel effects. These regulations are effective May 16, 2011 (76 FR 20870; April 14, 2011, and discussed below).

### *2.3.3.4 Non-Vessel Sound*

In-water construction activities are permitted by the Army Corps of Engineers (Corps) under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act of 1899 and by the State of Washington under its Hydraulic Project Approval (HPA) program. NMFS conducts consultations on these permits and helps project applicants incorporate conservation measures to minimize or eliminate potential effects of in-water activities, such as pile driving, to marine mammals. Sound, such as sonar generated by military vessels also has the potential to disturb killer whales.

### 2.3.4 Summary of Baseline Conditions for Southern Resident Killer Whales

Southern Resident killer whales are exposed to a wide variety of impacts in the action area from past and present state, federal or private actions and other human activities, as well as federal projects that have already undergone formal ESA Section 7 consultation, and state or private actions that are contemporaneous with this consultation. All of the activities discussed in the above section are likely to have some level of impact on SR killer whales when they are in inland waters of their range.

No single threat has been identified as the cause of the recent decline of the Southern Resident killer whales, although the three primary threats are identified as prey availability, environmental contaminants, and vessel effects and sound. Although it is not clear which threat or threats are most significant to the survival and recovery of SR killer whales, all of the threats identified are important to address. It is likely that multiple threats are acting together. For example, disturbance from vessels may make it harder for the whales to locate and capture prey, which may cause them to expend more energy to catch less food. The small size of the population increases the level of concern about all of these risks (NMFS 2008).

## 2.4 Effects of the Action on the Species and its Designated Critical Habitat

"Effects of the action" means 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).

### 2.4.1 Method of Analysis

In this step of our analysis, we evaluate the effects of the proposed action on the environment, including the geographic distribution, nature, intensity, timing, frequency, and or duration of the effect. We then look at effects on individual fish and on the affected population(s). Finally, we consider effects on the essential features (PCEs) of any designated critical habitat within the action area.

With the exception of the Corps' proposal to replace the White River diversion with a well-designed barrier dam, the proposed action is in most respects, a continuation of current MMD operations and configuration. All of the past effects of the project included in the Environmental Baseline would continue and likely worsen until the diversion dam is replaced. Additionally, although the existence of Mud Mountain Dam is in the baseline, we cannot distinguish its effects from those of the proposed action in any meaningful way because they are very closely



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intertwined. Therefore, our effects analysis of the proposed action includes the effects from the existence of the dam.

### 2.4.2 Analysis of Effects

In the sections below, we first identify the anticipated effects of each element of the proposed action and then we detail how the entire proposed action would affect the survival and recovery of the affected species and their critical habitats.

#### *2.4.2.1 Normal Tunnel Operations*

Under normal tunnel operations, all MMD discharge would take place through the 9-foot tunnel except during active flood control operations (typically November through February), or other actions that resulted in storing water in the reservoir. The 9-foot tunnel has been shown to be a substantial hazard to juvenile passage survival (R2 Resources 2013). Due to use of the 9’ tunnel, we anticipate that up to 82% of the annual production of juvenile PS Chinook salmon and PS steelhead from spawning areas upstream of MMD would be lost to mortality at the dam (see Section 2.3.2 Juvenile Passage). Operation of the higher, 23-foot diameter tunnel has been shown to be safe to migrating juveniles. However, this outlet would be used sparingly, primarily immediately after flood damage reduction operations because it only operates after the project stores water. Therefore, the proposed tunnel operations would kill up to 82% of downstream migrating juvenile salmon and steelhead as they pass MMD.

#### *2.4.2.2 Impoundment for Flood Risk Management and Flow Management*

The Corps would impound water at MMD to reduce downstream flood risk or to reduce flows to facilitate in-river work on the White River diversion. The reduction in flood flows would have implications for the fish and their habitats downstream from MMD. Battin et al. (2007) showed that Chinook salmon year class strength was inversely related to the magnitude of peak flows experienced in their natal streams during incubation. This is because high peak flows have been shown to scour redds and kill fry. Thus, this reduction in peak flows would benefit PS Chinook salmon incubating downstream from MMD. Because the White River diversion prevents most PS Chinook salmon from accessing the river reach between MMD and the White River diversion, this benefit accrues mostly to fish incubating downstream from the White River diversion. Because PS steelhead spawn and incubate during the spring and early summer, a period when damaging peak flows seldom occur, peak flow reduction at the project would have little if any effect on incubating PS steelhead eggs.

While peak flow reduction would reduce redd scour, it would also reduce the stream energy available for channel modification and rejuvenation, likely reducing subsequent spawning and rearing habitat availability. Spawning habitat is abundant in the White River, and the slight reduction in spawning habitat caused by flood control operations would be inconsequential. Rearing habitat is not as abundant and flood control operations would likely have a small adverse effect on juvenile survival by slightly reducing the habitat available to rearing juvenile PS Chinook salmon and PS steelhead downstream from MMD. The beneficial effects of peak flow reduction at this project, in terms of fish survival, would be substantially greater than the adverse effects.

By storing water during high flow events, the project would also disrupt the flow of sediment-laden floodwaters. The entrapped sediment would then be released at lower flows, which have less ability to keep released sediments moving, resulting in an increase in downstream sedimentation. Sedimentation is an ongoing problem at the intake for the MIT White River Hatchery. Such sedimentation events could also decrease PS Chinook salmon spawning success by suffocating eggs.

#### *2.4.2.3 Large Wood Management*

Large woody debris is an important component of salmonid rearing habitat, providing hiding cover, velocity cover, and expanding the benthos for insect colonization. The MMD would continue to interrupt the flow of LWD down the White River. Managing that debris by providing collected LWD to project outside of the White River would reduce the quantity of LWD in the White River downstream from MMD. The Corps would reduce this modest adverse effect by encouraging the use of collected LWD in White River habitat improvement projects.

#### *2.4.2.4 Fish Trap Operations*

The fish trap and haul system would be the only mechanism at the project that provides adult PS Chinook salmon and PS steelhead access to spawning and rearing habitats upstream of MMD. The anticipated effects of the trap and haul system would build on those presented in the Environmental Baseline (see Section 2.3.2 Adult Trap and Haul System). As time goes on, the trap and haul system would continue to deteriorate, causing all of the effects summarized below to worsen.

In summary, the adult salmon passage system would present the following hazards:
1. Injury and mortality at the dilapidated dam apron,
2. Injury and mortality in the inadequate and unsafe trap,
3. Delayed passage due to insufficient capacity of the trap and haul system, harming the fish by increasing their exposure to the hazards at the dam apron, disease, stress, and straying, and
4. Reduced ability to sort fish due to crowding, diminishing the ability of fish managers to meet current fish management goals, including maintaining the genetic integrity of the wild stock, thereby diminishing the likelihood of survival and recovery.

Continued delay, injury, and mortality of adult PS Chinook salmon and PS steelhead due to poor passage conditions at the White River diversion dam and trap and haul system, particularly during large pink salmon runs would reduce the abundance and productivity of both species.

Delay would exacerbate injury and mortality associated with the adult passage system. When fish reach the dam, they would attempt to continue upstream any way they could. While injuries would occur in the trap itself, the primary causes of injury and mortality due to delayed passage would be contact with exposed rebar and broken planking in the approach apron and headburn caused by the fish attempting to surmount the barrier dam. The longer the delay in accessing the trap, the more likely fish are to be injured or killed as they continuously search for a passage route and encounter hazards posed by the diversion dam. Fish injured at the barrier dam,



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particularly those that suffer headburn [15] are less likely to survive to spawn. This effect would be most severe during odd-numbered years, when PS Chinook salmon and hundreds of thousands of pink salmon arrive at the dam and trap at the same time. In the years when pink salmon numbers are small, there would continue to be injury and mortality to PS Chinook salmon and steelhead due to exposure to hazards at the dam and trap, but the duration of their exposure would be shorter, lessening the impact on abundance and productivity. [16]

The effects of the unsafe trap would be felt most strongly during odd-numbered years, when very large numbers of pink salmon arrive during August and September. Delay and crowding at the fish trap would extend the duration of the risk of injury or mortality at the diversion dam and trap for PS Chinook salmon. Difficulties in sorting fish to identify hatchery-origin fish needed to meet hatchery collection goals would be also worse in odd numbered years. Fish trap operations would have minimal effects on juvenile fish, however, small numbers may be impinged or entrained in the water supply to the fish ladder and trap facility. Because PS steelhead typically do not arrive at the trap during August and September, they would encounter the same physical hazards at the dam apron and trap as PS Chinook salmon, but they would not suffer extended exposure to these hazards caused by crowding, or other effects of delay.

Following replacement of the diversion dam, the extent of injury and death would decline substantially; however, delay would continue due to the inadequate trap and haul facility, and delay alone has been shown to reduce the likelihood of affected fish reaching their natal spawning grounds (Caudill, et al. 2007), suggesting increased pre-spawning mortality.

#### *2.4.2.5 White River Diversion Repairs*

The existing White River diversion would require frequent (~annual) repairs to perform its function as a fish passage barrier, until it is replaced. The Corps would fund maintenance on the barrier dam and operate MMD to facilitate safe conditions for repair work. When repair is scheduled, the Corps would operate MMD to reduce discharge to about 350 cfs at the diversion dam for human safety reasons to conduct maintenance. Downramping rate restrictions would be followed. The maintenance operations would be scheduled to occur when river flows are naturally low, such that the change in flow would be minimized, and dewatering of incubation and juvenile rearing habitat would also be minimized. Historically, losses of juvenile Chinook salmon and steelhead during diversion dam repairs have been very low, with unlisted coho salmon accounting for most of the mortalities.

#### *2.4.2.6 Tunnel Repairs*

The 9-foot tunnel through MMD would need frequent (~ once or twice each year) maintenance and repair due to the abrasive nature of the White River's extremely heavy sediment load and the

[15] Headburn is scalping or exfoliation of skin and ulceration of underlying connective tissue and muscle, primarily of the jaw and cranial region of salmonids observed at fish passage facilities.
[16] Quantitatively, about 18% of sampled Chinook at the trap exhibit external physical injuries, and about 20% of the Chinook taken to the MIT White River hatchery suffer pre-spawning mortality (MIT 2013). No quantitative information is available for steelhead. Most injuries are attributable to exposed rebar and other hazards at the diversion dam. Delay and crowding at the fish trap extend the duration of this risk.



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deteriorated condition of the tunnel's steel lining. The Corps would perform periodic maintenance on the 9-foot tunnel by reducing discharge and raising the reservoir pool elevation by 15 feet such that project discharge would be provided through the larger, 23-foot tunnel and then closing the 9-foot tunnel off at the upstream end and conducting repairs. All incoming water and fish would then pass the dam via the 23-foot diameter tunnel. This action would create a small reservoir behind MMD, which would likely negligibly delay juvenile downstream migration. If repair of the 23-foot diameter tunnel becomes necessary, it would simply be closed-off to facilitate repair and all project discharge would pass through the 9-foot tunnel. Because passage through the 9-foot tunnel has been shown to adversely affect the survival of outmigrating juvenile salmon, repairing that tunnel would likely beneficially affect PS Chinook and PS steelhead and their critical habitats by reducing or avoiding this hazard. Repair operations at the 23-foot tunnel would force all discharge and all outmigrating fish to pass through the 9-foot tunnel, which is how the project is routinely operated. Minor construction-related effects (liberating sediments) would likely occur during tunnel repairs.

#### *2.4.2.7 Woody Debris Storage and Disposal*

The likely effects of the Corps' management of woody debris are presented in Section 2.4.2.3 above.

#### *2.4.2.8 Minimal Sediment Management*

By storing water during high flow events, the project would disrupt the flow of sediment-laden floodwaters. The entrapped sediment would then be released at lower flows, which have less ability to keep released sediments moving, resulting in an increase in downstream sedimentation. Sedimentation is an ongoing problem at the intake for the MIT White River Hatchery, and therefore could affect the hatchery's ability to provide fish needed to help support survival and recovery. Such sedimentation events could also decrease PS Chinook salmon spawning success by suffocating eggs in spawning habitat downstream from the project.

#### *2.4.2.9 Repairs and Routine Maintenance of Facilities other than the Dams*

This aspect of the proposed action includes maintenance of recreation facilities, maintenance of roads and trails on project lands, and maintenance of MMD and support facilities. These activities would have little if any effect on the species considered in this Opinion because they would not affect project operations or fish protection facilities, and would mostly occur well away from the river.



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#### *2.4.2.10 Replacement of the Barrier Dam*

Replacing the White River diversion dam with a new fish barrier structure would occur behind temporary cofferdams, [17] so the potential impacts to juvenile and adult fish would be related to installation and removal of the cofferdams. Adult Chinook salmon and steelhead are able to, and likely would, avoid the area when cofferdams are being installed or removed, and therefore, there would likely be no injury or mortality of adult fish caused by installing the cofferdams. Juvenile fish in the immediate area of the cofferdam construction activity may be injured or killed prior to being displaced. Timing of such construction would be restricted to periods other than the active juvenile downstream migration season, so the potential loss is likely to be less than 100 each of juvenile Chinook and steelhead, based on the potential size of the area of aquatic habitat affected.

#### *2.4.2.11 Species-Specific Effects*

**Puget Sound Chinook Salmon**

Chinook salmon inhabit all of the action area, and continued operation and maintenance of MMD and the fish passage facility would negatively affect PS Chinook salmon by reducing upstream and downstream passage survival and reproductive success.

***Spawning, Incubation, and Early Juvenile rearing***

Downstream of the White River diversion dam, the proposed action would have both beneficial and adverse effects on PS Chinook salmon spawning, incubation and early juvenile rearing by decreasing redd scour and by slightly increasing sedimentation and by reducing channel complexity.

By reducing project discharge during high flow events, the proposed action would beneficially reduce redd scour and the loss of PS Chinook eggs, alevins, and fry in the river reach downstream from MMD, particularly during years with very high peak flows. This beneficial effect of the proposed action would accrue exclusively to Chinook salmon spawning downstream from MMD and primarily to fish spawning downstream from the White River diversion. Steelhead, which primarily spawn during the early spring and emerge in late spring or early summer, would only benefit from late season peak flow reductions, a rare event. Only about 20% of the White River PS Chinook salmon population spawns in the White River and its tributaries downstream from the diversion dam (R2 Resources 2014). Most spawning takes place upstream of MMD, so this effect would be small since it benefits only a small amount of the overall spawning habitat.

Minor floods are often termed channel-forming flows. Streams deprived of natural peak flows tend to narrow and incise, reducing the formation of side channels and other channel features conducive to juvenile salmon rearing (Trush et al. 2000). This project effect would occur throughout the river reach downstream from MMD.

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[17] A cofferdam is a temporary dam, designed to shunt water away from construction areas.

Mud Mountain Dam would continue to pass bedload gravel and other sediment derived from the upper watershed into the reach below the dam. Bedload sediment (e.g. gravels) movement would be slowed somewhat due to flow reduction, leading to greater deposition. The delay in the release of stored, sediment-laden water under flow conditions much lower than those that liberated the sediments, would increase downstream sedimentation and embeddedness in spawning habitat, thereby modestly reducing spawning success downstream from MMD. Such sediment releases would also continue to aggravate clogging of the water intake screens at the Muckleshoot Tribal fish hatchery that cultures listed Chinook salmon and steelhead (MIT 2013). Preventing full use of the hatchery in turn potentially prevents the Tribe from meeting the hatchery goals for enhancing the likelihood of survival and recovery.

Until replaced, the White River diversion dam would continue to require periodic maintenance (averaging annually) that would necessitate reducing the flow of the White River from normal flows (~800-2000 cfs) to about 350 cfs. The diversion dam is owned by CWA, but it is no longer necessary to serve CWA's needs. However, the dam is necessary to serve as a fish barrier for the Corps' trap and haul fish passage system and the Corps funds its operation and maintenance. Absent the diversion dam, it would not be possible to attract fish into the Corps fishway and trap. The Corps' trap and haul system is the only mechanism for salmon and steelhead to access high quality spawning habitats upstream of MMD.

Upstream of the diversion dam, the proposed action would continue to limit access to high quality spawning, incubating, and rearing habitats through the poorly functioning trap and haul system. This is discussed below under Adult Upstream Migration.

***Juvenile Downstream Migration***

The primary effect of the proposed action on outmigrating PS Chinook salmon juveniles would be the high level of mortality caused by passage through MMD using the 9-foot tunnel.

Outmigrating juvenile PS Chinook salmon from the upper watershed would pass through MMD, via either the 9-foot wide tunnel, or the higher, 23-foot diameter tunnel. Under the proposed action, the 9-foot tunnel would be the primary mechanism for the project to discharge inflowing water. As most project discharge would occur through the 9-foot diameter tunnel, most juvenile fish passage would also occur via this tunnel. A recent study (R2 Resources 2013, Corps 2013c) has shown that juvenile passage survival through the 9-foot diameter tunnel is low (~18%). This study used hatchery steelhead smolts for the test. The results for steelhead are not wholly applicable to Chinook. Both species outmigrate during the spring, but steelhead smolts are substantially larger than Chinook smolts and may be affected differently by passage through the tunnel. However, conditions encountered by both species are the same and the low measured survival for steelhead smolts suggest that Chinook smolt passage survival would be similarly low. The higher 23-foot diameter tunnel has had no observable effect on juvenile migrant survival, and would continue to provide safe passage (R2 Resources 2013). The low level of juvenile survival observed at the 9-foot tunnel is of concern because the core of spawning and rearing habitat for White River PS Chinook salmon and PS steelhead is located upstream of MMD as are acclimation ponds for hatchery-produced juveniles, and juveniles emanating from the upper watershed must pass through MMD on their seaward migrations. These are the fish needed to support future generations, and very few of the original numbers of smolts will survive below the dams. This results in a significant loss of population productivity for White River PS Chinook salmon and PS steelhead.

Once past MMD, downstream migrants would next have to pass over the White River diversion dam. This is the only way that smolts can get past diversion dam; to be carried over the dam with the water spilling over it. Because the dam apron has numerous small gaps and protruding rebar, the existing structure may injure or kill downstream migrating smolts as the water cascading over the dam falls on the apron that is in disrepair. No studies have been conducted on this hazard, so we have no definitive information on such effects. Based on our experience at other projects that employ juvenile passage systems, we consider the risks to migrating juveniles posed by the existing diversion dam to be small. However, this hazard will likely worsen as the dam ages and falls into worse disrepair.

***Adult Upstream Migration***

The trap and haul facilities and program for returning adults would continue. The proposed action would rely on the existing White River diversion dam to block upstream passage, forcing the fish into the Corps' trap, and would collect fish at the trap and haul them to the release point upstream of MMD. Some of the adults could be provided to the MIT White River hatchery, and hatchery production would continue to serve as a safety net, to increase abundance and reduce the potential for extirpation of the population. [18]

The primary effect to upstream migrating PS Chinook salmon would be delay, injury, and death associated with the trap and haul system, and the condition of the diversion dam. These effects are described in detail in Section 2.4.2.4 above, and likely will worsen over time as the condition of the facilities continues to deteriorate.

Ker (WCC 1999), in describing limiting factors to salmon recovery in the Puyallup/White River basins noted two key findings:

- Mud Mountain Dam and the Lake Tapps Hydroelectric Project adversely limit natural production of salmonids through several means. (The hydroelectric project was retired in 2004.)
- Mud Mountain Dam adversely impacts salmonid migration and production, and interrupts the recruitment of LWD and the natural sediment flow regime.

With regard to the condition of Chinook salmon in the Corps' Buckley fish trap, Kerwin (WCC 1999) said, "Numerous fish caught in this trap exhibit wounds characteristic of injuries sustained as the result of poor trap design and/or construction or false attraction problems associated with the tailrace outlet canal at the Dierenger powerhouse" (Note: Water no longer flows through the Dierenger powerhouse following project retirement in 2007, so false attraction to the tailrace is no longer an issue). Such injuries can adversely affect individual fish reproductive success and could reduce the fitness of the entire population should enough fish sustain such injuries (WCC 1999). He further noted that, "Currently White River spring chinook escapement numbers have increased primarily because of hatchery intervention programs initiated in the late 1970's."

[18] Recent statements by MIT indicate that it may not continue to raise White River spring Chinook in lieu of harvestable stocks (Coccoli 2014).

Up to 20% of White River Chinook adults collected as hatchery brood stock were lost to pre-spawning mortality in 2013 (MIT 2013, Ladley 2013). Actual pre-spawning losses are likely higher than this because hatchery personnel routinely cull the most seriously injured fish, meaning these more seriously injured fish are not taken into the hatchery but are transported upstream where they may succumb to their injuries unobserved. Stress and injuries associated with delay at the diversion dam reduce fecundity and increase pre-spawning mortality. Redd surveys conducted in non-glacial tributaries upstream of MMD suggest that up to 40% of transported Chinook salmon fail to spawn. While pre-spawning mortality includes losses caused by vectors other than dam passage (e.g. disease), given the high number of fish mortalities observed in the vicinity of White River diversion dam in 2013, it is likely that the primary cause of high Chinook salmon pre-spawning mortality is unsafe passage at the dam.

Until the diversion dam is replaced, headburn and pre-spawning mortality would occur at rates similar to those identified in the Environmental Baseline, starting at 10 – 20% as returning adults encounter and are delayed at the White River diversion, fishway, and trap. The harm to fish would worsen as time goes on because the dam and apron would continue to deteriorate, meaning that the percent of fish harmed would rise over time. Observations by the Corps, Puyallup Tribal staff, and Muckleshoot Tribal staff report that 18% of the returning adult Chinook salmon exhibit serious injuries. Muckleshoot hatchery staff report that after rejecting the worst injured adults, the hatchery still experiences approximately a 20% pre-spawning mortality among adult Chinook salmon. As few as 40% of transported fish have historically been observed actively spawning, suggesting a high rate of pre-spawning mortality on transported adults as well. These observations suggest that between 20% and 40% of the Chinook salmon that reach the White River diversion dam fail to reproduce, a high level of pre-spawning mortality. This high rate of mortality is likely to get worse as the dam and trap continue to deteriorate. As the dam apron erodes, more voids and rebar that injure and kill fish would be exposed. Also, until it is replaced, the existing diversion dam would continue to require periodic maintenance, requiring reduced discharge from MMD, continuing, and possibly increasing the frequency of, the attendant adverse effects of this facility described in Section 2.4.2.6 above.

Replacing the existing diversion dam with a new diversion weir would reduce or eliminate injury and mortality due to contact with the existing dam. It would not, however, solve crowding and passage delay problems at the trap. The Corps has not provided a schedule for completing construction of the new barrier dam, so we do not know when the adverse effects of the current dam would be abated. Based on the action as proposed, with no date for implementation, we cannot rely on the beneficial effects of a new diversion structure in our analysis of the proposed action. Because the Corps does not propose to modify the existing fishway and trap, delay and mortality associated with the existing trap and haul facility would continue and likely worsen. These effects would be particularly severe during odd numbered years when large numbers of pink salmon increase delay and complicate sorting to the point that at times sorting would be foregone and all collected fish would be transported, defeating the objective of controlling the number of hatchery origin spawners allowed to spawn upstream of MMD.



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***Summary of Effects on Puget Sound Chinook Salmon***
In summary, the proposed action would worsen certain effects identified in the environmental baseline; those associated with the 9' tunnel, barrier dam, and trap and haul facility; and continue the other effects:

- incubating eggs and pre-emergent alevins downstream from MMD would benefit from peak flow reduction which would reduce redd scour that would otherwise occur,
- incubating eggs and pre-emergent alevins downstream from MMD would suffer mortality from fine sediment deposition associated with high sediment releases into low stream flows,
- juveniles passing MMD through the 9-foot tunnel would suffer high rates of mortality,
- juveniles passing the White River diversion could be injured or killed by contact with the dam's dilapidated apron,
- adults delayed at the diversion dam and in the fishway facility would suffer injury and mortality through contact with the dam's dilapidated apron, crowding and injury in the trap, and diminished vigor and fecundity,
- hatchery management that supports the survival of the White River population, and ESU recovery goals would be harmed by difficulties in sorting fish during odd numbered years when large numbers of pink salmon enter the fishway and trap at the same time as PS Chinook salmon adults.

In aggregate, without modification, the continued operation and maintenance of the MMD project would reduce juvenile smolt abundance due to smolt losses as they pass through MMD and would reduce spawner abundance due to delay, injury, and mortality to upstream migrating adult salmon at the diversion dam and trap-and-haul fishway facility. This would reduce the abundance and productivity of PS Chinook salmon natural-origin spawners (NOS) in the White River. Also, by limiting the ability to sort and collect Chinook for the White River hatchery the proposed action would reduce the hatchery's ability to operate in accordance with its hatchery genetic management plan and would reduce the production of PS Chinook salmon. Despite over two decades of hatchery operations aimed at restoring White River spring Chinook salmon, the average return of natural origin recruits per spawner since retirement of the White River Hydroelectric Project in 2004 is 0.415, meaning the population resulting from natural production, without direct hatchery assistance cannot replace or maintain itself, but is decreasing by about half each year. MMD facilities and operations would be a primary direct cause of the mortality to juvenile and adult salmon, and the decreasing numbers of these fish.

**<u>Puget Sound Chinook Salmon Designated Critical Habitat</u>**

The PCEs of critical habitat for PS Chinook salmon that occurs within the action area for this consultation are "freshwater spawning sites, incubation, and larval development, rearing sites, and migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival" (McElhany et al. 2000). Proposed project effects on freshwater juvenile and adult migration corridors including obstructions, predation, and water quality and quantity are summarized in Table 4.

**Table 4. Project effects on PS Chinook critical habitat**

| PCE feature | Project effect |
|---|---|
| Support spawning, incubation, and larval development. | **Upstream of MMD**: The project has no effect on conditions supporting spawning, incubation, and larval development upstream of MMD. **Downstream from MMD**: The project would pass most incoming sediments, including spawning-sized gravels and cobbles, maintaining high quality spawning habitat downstream. Slight adverse effects of sedimentation would be much smaller than the benefits of reduced redd scour from peak flow reduction. Managed dewatering for diversion dam maintenance during incubation could kill incubating eggs and alevins and could strand rearing juveniles on dewatered gravel bars and potholes. |
| Freshwater rearing sites with:<br>(i)Water quantity and floodplain connectivity;<br>(ii)Water quality and forage<br>(iii)Natural cover, shade, submerged and overhanging wood, log jams, etc. | The action area downstream from MMD contains a mix of connected and unconnected floodplain. By reducing peak flows, the proposed action would continue existing channel simplifying conditions and effects. Diversion dam repair would continue to require low flows and reducing flows could entrap and strand juveniles downstream from the dam.<br><br>The proposed action has the potential to release sediment to the downstream river channel and cause a temporary increase in turbidity. Water quality and quantity are otherwise unaffected. |
| Freshwater migration corridors free of obstruction and excessive predation. | Project operations include downstream passage through the 9-foot tunnel at MMD and its associated high mortality. Upstream passage is unsafe because of delay, injury and mortality rates at the White River diversion, fishway, and trap. |
| Estuarine, nearshore marine & offshore marine areas. | Would be unaffected by the proposed action. |

As described above in the Environmental Baseline section, White River water quality is fair in the project action area. Construction work replacing the White River diversion would have the potential for temporary adverse effects due to excessive turbidity and sediment loading during construction, and direct physical impacts depending on the timing, design, and construction of temporary cofferdams. Pollution or water contamination could occur should a gas or oil spill introduce those chemicals into the river during demolition and construction; however, the Corps proposes to employ preventative and containment measures that would minimize this possibility. The effects of constructing a new fish barrier structure on PCEs would be small to moderate because they would attenuate in the downstream direction and be temporary in nature and the new fish barrier would substantially increase adult migration success. Spawning habitat is abundant in the White River and flood control operations would reduce the potential for redd scour downstream from MMD. This effect would only benefit egg-to-fry survival downstream from MMD, while the majority of PS Chinook salmon spawning and the best spawning habitat occur upstream of MMD. Flood control operations would also disrupt sediment transport, adding to substrate embeddedness downstream from MMD, slightly reducing spawning success.

In summary, the spawning PCE for PS Chinook salmon downstream from MMD would be improved by the proposed action. Downstream migration corridors would be adversely affected and poor for migrating juveniles at MMD due to poor survival through the 9-foot tunnel, the primary discharge system. The upstream migratory corridor via the White River diversion and fish trap would be adversely affected by imposing delay, injury and mortality on returning adults. It is unlikely that the proposed action would have any effect on the conservation value of critical habitats in the estuary or nearshore marine environments.

**Puget Sound Steelhead**

White River steelhead inhabit all of the action area. Operation and maintenance of MMD would negatively affect PS steelhead by reducing upstream and downstream passage survival and reproductive success. Operation of the project would also continue to affect PS steelhead proposed critical habitat.

***Spawning, Incubation, and Early Juvenile rearing***

The proposed action would reduce peak flows and contribute to sedimentation downstream from MMD. This would adversely affect steelhead spawning, incubating, and juvenile rearing habitat downstream from MMD. The majority of PS steelhead spawn in the White River and its tributaries upstream from MMD because this is better habitat for them. The proposed action would limit access to spawning, incubating, and rearing PS steelhead habitat upstream of MMD, as explained in the section below on effects on adult migration.

White River steelhead spawn upstream and downstream of Mud Mountain Dam primarily from April into early June, with a peak in May (PTF 2006). The spring runoff begins in May, with the highest sustained streamflows in June. So steelhead eggs and alevins incubate during a period of increasing flows, and complete incubation and emergence occurs as flows recede.

Flooding is infrequent on the White River during the spring months in which steelhead spawn, incubate, and emerge, meaning that active flood control operations would have only slight effects on spawning steelhead. However, by reducing channel complexity, continued flood flow reduction would slightly reduce downstream spawning habitat.

***Rearing and Migration within the Action Area***

The proposed action would include periodic flow reductions to facilitate repairing the White River diversion that could entrap and strand juveniles, and would pass outmigrating PS steelhead smolts through MMD primarily via the 9-foot tunnel and over the White River diversion. Both of these measures would substantially reduce juvenile PS steelhead survival.

Rearing juveniles beyond the early fry stage could be entrapped or stranded by the partial dewatering of the river during diversion dam maintenance events. This effect would be most severe on post-emergence fry smaller than 50 mm (RW Beck 1989).



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The main effect on steelhead rearing and migration would be during their seaward out-migration as smolts. Most steelhead habitat and production occurs upstream of MMD. This means that most outmigrating steelhead smolts have to pass through MMD and White River diversion where they experience high mortality. Like Chinook salmon smolts, they migrate during the spring, but steelhead smolt out-migration is somewhat more compressed in time and peaks a few weeks later. Even so, the average river project discharge would be less than the 2,000 cfs capacity of the 9-foot tunnel, meaning that the Corps would primarily use the 9-foot discharge tunnel during the juvenile PS steelhead outmigration. As described previously, the 2012 steelhead smolt study by the Corps (R2 Resources 2013) indicates only 18% of the acoustically tagged steelhead smolts definitively survived passage through the dam, a very low rate of survival. [19] While these data are not conclusive, this study is the best scientific evidence of MMD passage survival available, and indicates that passage through MMD's 9-foot tunnel would cause significant mortality to juvenile steelhead. Smolts that survived passage through MMD would then pass over the White River diversion, which is in rough condition and poses an additional small risk to smolt survival. As the diversion dam continues to age, it will likely cause an increased amount of harm to smolts because the approach apron (dam surface smolts come into contact with) would continue to deteriorate through time and become rougher and more hazardous to smolts. Such high mortality rates mean that very few smolts would survive to reach Puget Sound.

***Adult Upstream Migration***

The proposed action would rely on the existing White River diversion dam to block upstream passage, forcing the fish into the Corps' trap, and would collect fish at the trap and haul them to the release point upstream of MMD where they could migrate further, spawn, and rear. Historically, the Corps has provided some trapped steelhead adults to the MIT White River hatchery for its small-scale steelhead production program that serves as a safety net, increasing abundance and reducing the potential for extirpation of the population. This program would continue. [20]

Upstream migrating steelhead adults encountering the White River diversion, fishway, and trap and would suffer delay, injury, and mortality at those facilities. The condition of these facilities will deteriorate over time, causing increased harm. Due to their small population size, and because PS steelhead enter the White River in the winter, when flows are high and other species do not crowd the site, the extent of delay, injury and mortality would be lesser than those observed in PS Chinook salmon, but still significant. Replacing the White River diversion would substantially reduce adult steelhead injury and mortality associated with the existing structure. However, there is no date certain for this replacement so we cannot rely on these improvements in performance in reaching our conclusions.

[19] The relatively high flows (~2,500 cfs) that occurred during this study indicate that discharge through the 9-foot tunnel was pressurized, which would cause high velocities and high turbulence in the tunnel, may have contributed to low survival.

[20] The Muckleshoot Tribe has been collecting small numbers of steelhead broodstock since 2007 for artificial propagation as a conservation measure and has expressed that it intends to continue doing so.

***Summary of Effects on Puget Sound Steelhead***

In summary, the proposed action would include all of the effects identified in the environmental baseline, and increase the severity of those effects due to deterioration of the trap and haul, and barrier dam:

- rearing juveniles downstream from MMD could be entrapped and stranded when flows would be reduced to provide safe working conditions for periodic repairs at the White River diversion,
- juveniles passing MMD through the 9-foot tunnel would suffer high rates of mortality,
- juveniles passing the White River diversion could be injured or killed by contact with the dam's dilapidated apron,
- adults blocked at the diversion dam would suffer injury and mortality through contact with the dam's dilapidated apron until they located the fishway and entered the trap.

Steelhead abundance would likely decline due to substantial losses of juveniles as they pass downstream through the 9' tunnel, and losses of adults at the diversion dam and trap and haul facility. By reducing the survival of migrating fish, the proposed action would reduce both abundance and productivity, risking extirpation of the population and reducing its likelihood of recovery.

***Puget Sound Steelhead Proposed Critical Habitat***

NMFS has proposed, but not yet designated critical habitat for PS steelhead (NMFS 2013). The proposed critical habitat includes all occupied habitat in the sub-basin, including the reach between the diversion dam and MMD. We are including an analysis of the effects of the proposed action on this proposed critical habitat, so that when NMFS issues a final designation and if no new information alters our conclusions and the designation has not changed significantly from what has been proposed, then this consultation would be valid for PS steelhead critical habitat and reinitiation of this consultation would not be required.

The PCEs of the proposed critical habitat that occurs within the action area for this consultation are "freshwater spawning sites, incubation, and larval development, rearing sites, and migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival." Project effects on freshwater juvenile and adult migration corridors including obstructions, predation, and water quality and quantity are summarized in Table 5.

**Table 5. Project effects on PS steelhead critical habitat in White River sub-basin.**

| PCE feature | Project effect |
|---|---|
| Support spawning, incubation, & larval development. | Managed dewatering for diversion dam maintenance during incubation would kill incubating eggs and alevins and could strand rearing juveniles in the downstream river reach. Replacing the diversion dam may cause limited temporary adverse effects, but the periodic dewatering for maintenance would be avoided long term. |
| Freshwater rearing sites with:<br>(i)Water quantity and floodplain connectivity;<br>(ii)Water quality and forage<br>(iii)Natural cover, shade, submerged & overhanging wood, log jams, etc. | Peak flow reduction would reduce downstream channel complexity, slightly reducing floodplain connectivity and juvenile rearing habitat. Water quantity and quality is satisfactory. The proposed action would continue existing conditions and reduces the incidence of dewatering if the proposed replacement of the diversion dam occurs. The proposed action would have the potential to release sediment to the downstream river channel and cause a temporary increase in turbidity. Water quality and quantity would be otherwise unaffected. |
| Freshwater migration corridors free of obstruction and excessive predation. | Project operations would include juvenile fish passage through the 9-foot tunnel at MMD and its associated high mortality. Upstream migrating adults would continue to suffer delay, injury and mortality at the White River diversion and trap. This adverse effect would be reduced when the Corps replaces the dam. |
| Estuarine, nearshore marine & offshore marine areas. | These are outside the project action area, and no project effect on them has been identified. |

The proposed action would continue habitat-degrading actions identified in the Environmental Baseline, leading to additional habitat loss. Access to spawning and rearing habitats upstream of MMD would be obstructed by the poor performance of the trap and haul system, but that effect would be lesser than that experienced by PS Chinook salmon due to higher flows during migration and little if any crowding and delay associated with difficulties in passing large numbers of fish. Adult steelhead would be exposed to all of the hazards posed by the poor condition of the White River diversion dam until they locate and enter the fishway. The juvenile migration corridor would be obstructed by MMD due to the high level of mortality observed at the primary MMD discharge system, the 9 foot tunnel. The proposed action would modestly reduce spawning and rearing habitats downstream from MMD by reducing channel maintaining and forming peak flows.

## Southern Resident Killer Whales

Our analysis of effects on SR killer whales focuses on the effects of the proposed actions on quantity of Chinook salmon available to the whales, because the only effect the proposed action could have on SR killer whales would be on their prey base. . In this analysis, we considered effects of the proposed actions on the SR killer whales by qualitatively evaluating the reduction of prey availability. We rely on the salmon determinations to ensure that the proposed actions do not appreciably reduce the likelihood of survival and recovery of the SR killer whales in the long term. Later in this opinion, NMFS concludes that the proposed actions are likely appreciably reduce the likelihood of survival and recovery of the PS Chinook salmon. In other words, the proposed action appreciably increases the risk of extinction of this listed species.

The best available information indicates that Chinook salmon are their primary prey (Hanson et.al, 2010) and the other affected salmonids, chum and steelhead, are smaller components of their diet. To survive in the near term, SR killer whales require regular supplies of adult Chinook salmon prey in marine waters, and to recover over the longer term, SR killer whales require access to abundant Chinook salmon stocks across their range (from the Queen Charlotte Islands south to Central California and inland waters of Washington State and British Columbia), including stocks from the Puget Sound (NMFS 2008). This analysis considers the short-term and long-term reductions in Chinook salmon available to the whales as a result of the proposed action.

Short term or annual reduction in Chinook salmon stocks

Mortality of Chinook salmon could affect the annual prey availability to the whales where the marine ranges of the affected Chinook salmon stocks and the whales overlap. Mortality of adult Chinook salmon could affect the quantity of prey available to the whales in a given year, whereas mortality of juvenile Chinook salmon could affect prey availability in future years. Juvenile mortality from the proposed project translates to the effective loss of only a few adult-equivalent Chinook salmon from a variety of runs three to five years after the juvenile mortality occurred (*i.e.*, by the time these juveniles would have grown to be adults and available prey of killer whales). This reduction would occur each year.

Long term reduction in the likelihood of survival and recovery of PS Chinook salmon

NMFS qualitatively evaluated long-term effects on the SR killer whales from the anticipated appreciable reduction in the likelihood of survival and recovery of PS Chinook salmon. We assessed the likelihood for localized depletions, and long-term implications for SR killer whales' survival and recovery, resulting from the increased risk of extinction of PS Chinook salmon. In this way, NMFS can determine whether the increased likelihood of extinction of prey species is also likely to appreciably reduce the likelihood of survival and recovery of SR killer whales.

A reduction in prey would occur over time as PS Chinook salmon abundance declines. Hatchery programs, which account for a portion of the PS Chinook ESU, may provide a short-term buffer, but it is uncertain whether hatchery-only stocks could be sustained indefinitely. The loss of this ESU would also preclude the potential for their future recovery to healthy, more substantial numbers. Fewer populations contributing to SR killer whales' prey base will reduce the representation of diversity in life histories, resiliency in withstanding stochastic events, and redundancy to ensure there is a margin of safety for the salmon and SR killer whales to withstand catastrophic events. The long-term effects of the action would permanently reduce prey quantity needed to support individual and population growth of the SR killer whales.

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

As an early timed PS Chinook salmon run, White River Chinook spend more time in and around Puget Sound waters and therefore are more available as prey to SR killer whales than other populations of PS Chinook salmon. The proposed action would reduce the prey available to SR killer whales. The continued decline and potential extinction of the PS Chinook salmon, and consequent interruption in the geographic continuity of salmon-bearing watersheds in the SR killer whales' inland range, is likely to alter the distribution of migrating salmon and increase the likelihood of localized depletions in prey, with adverse effects on the SR killer whales' ability to meet their energy needs. A fundamental change in the prey base originating from the Puget Sound is likely to result in SR killer whales abandoning areas in search of more abundant prey or expending substantial effort to find depleted prey resources. This potential increase in energy demands should have the same effect on an animal's energy budget as reductions in available energy, such as one would expect from reductions in prey.

In summary, the proposed action would appreciably reduce the potential for recovery of the species because of impacts to its prey base.

**Southern Resident Killer Whale Critical Habitat**

NMFS published the final rule designating critical habitat for SR killer whales on November 29, 2006 (71 FR 69054). Critical habitat includes approximately 2,560 square miles of inland waters including Puget Sound, but does not include areas with water less than 20 feet deep relative to extreme high water. The PCEs of SR killer whales critical habitat are: (1) Water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging.

Sufficient quantity, quality and availability of prey are an essential feature of the critical habitat designated for SR killer whales. Increasing the risk of a permanent reduction in the quantity and availability of prey and the likelihood for local depletions in prey in particular locations and times reduces the conservation value of critical habitat for SR killer whales.

The proposed actions would likely reduce the quantity of prey available in critical habitat. The proposed actions would not have any effect on marine water quality or passage of SR killer whales. The previous discussion of the effects on SR killer whales as a result of decreased prey availability is also relevant to effects on the prey feature of critical habitat. As described previously, project operations would reduce the amount of SR killer whales primary prey.

In summary, critical habitat for SR killer whales would be adversely modified by the proposed action due to the loss of Chinook salmon, their primary prey species, and an essential primary constituent element of their critical habitat.

## 2.5 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). 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 Act.

In this section, we highlight numerous actions that have multiple components, portions of which have already occurred, and others which are planned to occur in the future. For ease of understanding the complete picture, we are providing descriptions of each program and state which components have already occurred, and which are anticipated future actions. The components of the actions that have already occurred have effects that contributed to conditions in the environmental baseline, thus while not separating out those components here; we included their effects in the baseline section.

### 2.5.1 Puget Sound Chinook salmon and Puget Sound steelhead

Activities that we include here as cumulative effects are; state, tribal or local agency actions such as the Washington State legislation to enhance salmon recovery through tributary enhancement programs, Washington's Total Maximum Daily Load (TMDL) development, ongoing climate change and implementation, state efforts to reduce greenhouse gas emissions and respond to climate change, human population growth and associated land use changes, and tribal efforts to restore native culturally important fish populations in the action area.

#### *2.5.1.1 Human Population Growth, Land Use, and Climate Change*

Some characteristics of the environmental baseline in the action area described above are expected to change over time due to the effects of increased human population in the Puget Sound region, attendant changes in land use, and climate change. (Climate change is discussed in Section 2.2.4). The Puget Sound Regional Council anticipates that the Puget Sound region's population will grow from about 3.7 million in 2014 to almost 5 million by 2040 (PSRC 2013 ). This growth will likely occur mostly within existing urban areas and their peripheries located in valley bottoms and the coastal plain. For the White/Puyallup watershed this implies that undeveloped lands from Buckley to Tacoma will become increasingly urbanized. With such urbanization would come increased water pollution, more channel simplification and bank hardening to protect developed property, and reduced instream flows due to diversion to serve municipal and industrial water demands. The overwhelming majority of this change will occur within the lower White River watershed as the upper watershed is primarily undeveloped forestlands.

By contrast, within the upper watershed, timber harvesting would likely continue to be the primary economic activity. It is possible that timber harvesting would increase as the increasing human population creates increased demand, and could result in increasing the road network. Both timber harvesting and forest roads produce high levels of sediment, degrading the quality of receiving waters.

As described in Section 2.2.4, recent projections of the likely physical changes in fish habitats in the Puget Sound ecoregion from the changing climate are increased water temperatures and increased peak flows (floods). Both of these changes are expected to adversely affect PS Chinook salmon and PS steelhead throughout the action area. However, because MMD acts to limit downstream peak flows, we anticipate that redd scour, the primary adverse effect of high peak flows on fish survival, would be only slightly increased in the lower White River. The upper White River, which has no impoundments to reduce peak flows, would likely be subject to increased redd scour during the winter, primarily affecting PS Chinook. The PS steelhead spawn during the spring and would not be affected by increased winter peak flows. Increasing water temperatures would affect all reaches of the White River. However, due to the fact that air temperatures and thus stream temperatures decrease with increasing elevation, the upper White River is and will remain cooler than the lower White River which today is only marginally suitable for rearing salmonids during the summer. Hence, warming water temperatures associated with climate change are more likely to adversely affect fish habitats in the lower White River than fish habitats in the upper White River.

#### *2.5.1.2 Washington State*

Several legislative measures have been passed in the State of Washington to facilitate the recovery of listed species and their habitats, as well as the overall health of watersheds and ecosystems. The 1998 Salmon Recovery Planning Act provides the basis for developing watershed restoration projects and establishes a funding mechanism for local habitat restoration projects. The Salmon Recovery Planning Act also created the Governor's Salmon Recovery Office, to coordinate and assist in the development of salmon recovery plans. Although this Act is already in effect, it directs future actions to support salmon recovery.

The Statewide Strategy to Recover Salmon is also designed to improve watersheds, while the 1998 Watershed Planning Act encourages voluntary water resource planning by local governments, citizens, and Tribes in regards to water supply, water use, water quality, and habitat at the water resource inventory area (WRIA) level. The Salmon Recovery Funding Act established a board to approve localized salmon recovery funding activities.

The WDFW and Tribal co-managers implemented the Wild Stock Recovery Initiative in 1992 and completed comprehensive management plans that identify limiting factors and habitat restoration activities. These plans also include actions in the harvest and hatchery components.

Although the Washington legislature amended the Shoreline Management Act to increase protection of shoreline fish habitat, a recent court challenge will delay implementation and possibly require additional amendments. Washington's Forest and Fish Policy is designed to establish criteria for non-Federal and private forest activities that will improve environmental conditions for listed species, primarily to minimize impacts to fish habitat through protection of riparian zones and instream flows. These actions are likely to gradually improve habitat productivity and capacity and result in long-term benefits, although little may be seen in the near term.

The State of Washington has also undertaken several initiatives to reduce emissions of greenhouse gases (primarily carbon dioxide). This effort involves efforts to reduce emissions from transportation by reducing motor vehicle miles driven, adopting low emissions standards (California standards), implementing fuel quality standards, provisions for electric vehicles, and others. To reduce emissions from electrical generating stations, the state has set building efficiency standards, including retrofits of existing public buildings, and efforts to encourage greater use of renewable energy. The state's overall goal is to achieve 1990 levels of greenhouse gas emissions by 2020, to be 25% below 1990 levels by 2035, and to be 50% below 1990 levels by 2050 (RCW 70.235.020 – Washington Legislature 2008). Washington has also conducted a comprehensive assessment of the likely impacts of climate change on the state and has developed climate change mitigation and adaptation programs. Based on the state legislative initiatives, there would likely be many follow-up actions that will be aimed at reducing greenhouse gases. While these programs and regulations are likely to be beneficial, climate change and emission of greenhouse gases are global issues and climate projections continue to show adverse climate effects for decades to come.

***Tribes***

The Muckleshoot Indian Tribe and Puyallup Indian Tribe are treaty tribes and co-managers with Washington State of salmon harvest under a draft Harvest Management Plan (HMP) (PSIT and WDFW 2009). Harvest significantly affects the abundance of salmon and steelhead in the basin, and consequently the number of fish potentially affected by project operations. The plan notes that recovery to substantially higher abundance is primarily dependent on restoration of habitat function. The HMP is designed such that harvest will not significantly reduce the likelihood of survival and recovery of the ESU (PSIT and WDFW 2009).

***Cascade Water Alliance***

Cascade Water Alliance is a municipal water supply consortium that has acquired many of the assets of the former White River Hydroelectric Project from Puget Sound Energy. Cascade Water Alliance obtained a Municipal and Industrial water right from WDOE to divert up to 72,400 acre-feet annually, at a rate not to exceed 1,000 cfs from the White River at the White River diversion for recreation (Tapps Lake) and municipal water supply. Except during the annual refill of Tapps Lake, actual diversions would be the minimum needed to meet municipal water needs, estimated to be about 100 cfs, but is likely to increase through time. Consumptive use will reduce the flows in the lower White and Puyallup Rivers. Cascade Water Alliance's water diversion, however, is conditioned by the minimum instream flows described in Table 3, above. These minimum instream flows were set to meet all anadromous fish migration, spawning, incubation, and juvenile rearing needs.

Prior to 2004, up to 2,000 cfs was routinely diverted at the White River diversion to supply the White River Hydroelectric Project, which has been decommissioned. Because the water rights associated with that project have been permanently transferred to CWA, recent and future flow conditions and associated fish habitat values between the White River diversion and the river's confluence with the Puyallup River are much higher than they were prior to 2004. The increased flow is a benefit to listed fish because it expands available habitat, particularly for upstream migrating adults.

***PS Chinook Recovery Plan and the Shared Strategy for Puget Sound***

The Shared Strategy for Puget Sound, a regional collaborative effort of state and local governments, tribes, interested citizens, technical experts, and policy makers in the Puget Sound region, developed a proposed recovery plan for PS Chinook salmon and other ESA-listed species and submitted it to NMFS in 2002 (Shared Strategy 2002). NMFS (2006) supplemented the Shared Strategy plan and, after the Shared Strategy participants agreed to the NMFS supplement, adopted the two documents as the species' recovery plan in January 2007. The plan focuses on regional actions and regulations to improve watershed health, thereby improving the status of the species. The State of Washington then enacted The Puget Sound Partnership Act (Section 49(3), RCW 77.85.090(3)) on January 1, 2008 to coordinate plan implementation. This broad, regional support for PS Chinook salmon recovery planning strongly suggests that over time, the plan will be implemented and measurable improvements in the status of the species will ensue. However, plan participants estimate it will take between 50 and 100 years to fully implement the plan.

In 2011, NMFS evaluated progress, to date, in implementing the recovery plan (Judge 2011) and identified the following accomplishments by numerous parties:

- The Co-Managers (the WDFW and Puget Sound Treaty Tribes, collectively) met or exceeded the harvest management performance measures required in the 2004 Harvest Management Plan.
- The WDFW completed its 21st Century Salmon and Steelhead Initiative, which will help them identify, monitor and evaluate long-term, science-based hatchery management strategies.
- Numerous high priority habitat restoration projects have been accomplished across every watershed in Puget Sound, funded by local government and private parties.
- The Nisqually watershed completed a major portion of their largest project, the Nisqually Refuge Estuary restoration project, with the support and shared contribution of funds from other South Sound watershed groups.
- The Elwha River Dam removal project, funded by the Federal government, is near completion. [21]
- Despite a severe recession, significant change in the organizational structure supporting Puget Sound salmon recovery, a loss of staff and severe funding shortages; the local commitment to salmon recovery across the ESU remains firm and work is continuing.

[21] Elwha Dam was removed in 2012 and Glines Canyon Dam has been breached, allowing fish unencumbered access to over 70 miles of spawning and rearing habitat. All Elwha Project works are scheduled to be removed by September 2014.

Given this substantial ongoing effort to recover PS Chinook salmon, it is likely that the Puget Sound Partnership will continue to provide increasing benefits to salmon and steelhead recovery into the future.

### 2.5.2 Southern Resident Killer Whales

A large number of state and private organizations participated in developing the SR killer whale recovery plan and many of these organizations have made commitments to implement portions of that plan (NMFS 2008). Some recovery plan actions identified as necessary for recovery of the species involve normal state agency regulatory functions (e.g. minimizing contaminant discharges). These actions that have been ongoing since listing are part of the environmental baseline that is expected to continue into the future. Other recovery plan actions engage private groups in efforts to educate the public to reduce injuries associated with boat collisions and other effects of whale watching. Several of these actions have been implemented and are increasing protections for SR killer whales. However, because funds to implement state and private actions identified in the recovery plan may not become available, we cannot rely on all actions in the recovery plan to be implemented.

***Summary of Cumulative Effects***

State, tribal and private entities have adopted programs (e.g. Puget Sound Partnership) designed to improve the statuses of PS Chinook salmon, PS steelhead, and SR killer whales. Some actions under these programs have already been implemented and their effects to date are reflected in the current status of the species and the environmental baseline, and may make further contributions to the species' survival and recovery in the future. It is likely that as these programs mature, additional actions will be taken, as described in this section, and that future benefits would accrue to SR killer whales, PS Chinook salmon, and PS steelhead,

## 2.6 Integration and Synthesis

The Integration and Synthesis section is the final step of NMFS' assessment of the risk posed to species and critical habitat as a result of carrying out the proposed action. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and critical habitat (Section 2.2).

The White River's Chinook salmon and steelhead populations are an important part of their larger ESU and DPS, and are needed to support species abundance, productivity, and spatial diversity. Maintaining and increasing the number of viable populations (spatial diversity) is important to minimize the potential for a single catastrophic event to wipe out an entire species. Hence, the White River populations of PS Chinook salmon and PS steelhead are essential to the long-term survival and potential for recovery of both species. The abundance trend lines for White River Chinook salmon and steelhead over time have negative slopes (Ford et al 2011), meaning that their numbers are decreasing over time. If allowed to continue, this negative abundance trend would eventually lead to the populations' extirpation. The trend lines for the entire Puget Sound Chinook salmon ESU and that of the Puget Sound steelhead DPS are similarly negatively sloped, indicating a moderate to high risk of species extinction.

White River Chinook abundance dipped to an all-time low in the late 1980s when only 8 fish returned to the Buckley trap. The WDFW took some of the remaining fish and cultured them at the Minter Creek hatchery to prevent their extinction. The Muckleshoot hatchery came on line in the late 1980s and the MIT has been propagating White River Chinook salmon ever since. But for these hatchery efforts White River Chinook salmon would likely be extinct today. Currently, production at the Muckleshoot hatchery (funded by the Tribe and the Bureau of Indian Affairs) reduces the risk of population extirpation caused by mortalities experienced by fish passing MMD and the trap-and-haul fishway.

The TRT and NMFS Science Center describe the equilibrium abundance of a recovered White River Chinook population at 14,200, with an escapement value of 3,225 (the number of adult salmon needed to reach spawning grounds each year). Returns of NORs (fish that are wild, not hatchery raised) have averaged about 1,300 in recent years and have plateaued. The difference between the total adult population at recovery (14,200) and the level of escapement necessary to support the population (3,200) is the number of adults expected to be lost prior to reaching spawning habitat, primarily due to total harvest and pre-spawning mortality. Achieving this recovery goal would require increasing the survival and productivity of migrating juveniles and adults at the MMD Project.

White River steelhead returns presently average about 265 adults, and have an average annual growth rate of 0.933 from 1995 through 2009 (Ford et al 2011). A value less than 1.0 means they are declining in abundance. This negative abundance trend indicates that the likelihood of long-term population survival is low. The population growth trend line for the Puget Sound steelhead DPS is also less than 1.0. Thus, both the White River steelhead population, and the overall DPS' numbers are declining, making reversing this trend imperative for their long-term survival. The Muckleshoot hatchery began culturing White River steelhead in 2006 to minimize the potential for their extirpation.

Unsafe and ineffective fish passage conditions at MMD and the White River diversion dam that injure and kill fish, as well as severely limit access to and utility of upstream spawning and rearing habitat, are among the primary causes of the declines in the abundance of both PS Chinook and PS steelhead in the White River. Other potential causes of population decline (e.g. overfishing, loss of habitat) are being addressed by other parties. The Muckleshoot Tribe has scaled back its fishing for White River Chinook salmon since the 1950s due to declining abundance caused by habitat degradation and restricted access to habitat. Salmon fishing in Puget Sound has been restricted to allow White River Chinook salmon to reach the Puyallup and then White River. Forest practices have been improving in Washington since legislated changes in 1973, 1990, and 1998. Land development in rural and urban areas of the White River basin has been further restricted since 1989 in large part to protect fish habitat. Road and transportation projects and waterway projects have been developed in consultation with NMFS (since 1998) to avoid degradation of fish habitat. As a result, spawning and rearing habitats in the White River watershed upstream of MMD have been improving in recent years. Puget Sound Energy retired its White River hydroelectric project in 2004, returning natural flows to the White River downstream from the White River diversion and providing a major improvement to fish habitat in the lower White River. Unsafe and ineffective fish passage performance at the MMD Project and the White River diversion dam stand as major obstacles to improving White River Chinook salmon and steelhead abundance and productivity. With the action as proposed, we cannot rely on the anticipated effects of replacing the White River diversion dam with a safe and effective fish barrier structure due to the lack of a specified completion date, these poor passage conditions would be unchanged by the proposed action, and would worsen over time as the structures and facilities deteriorate.

Effects of the proposed action on SR killer whales would be due to the project's adverse effects on Chinook salmon, the whales preferred prey.

In summary, the numbers of PS Chinook salmon in the ESU and PS steelhead in the DPS are declining, leading to a moderate to high risks of extinction. Baseline conditions are not good. The cumulative effects are mixed, population growth, land use and climate change will have negative effects, while ongoing recovery actions will be beneficial. The White River populations of both are essential to their survival and recovery for a number of reasons, including that they are needed to increase overall population numbers and to increase their spatial diversity. Spawning and rearing habitat below the project is already being utilized by both species, but is not adequate to allow for increasing the numbers of fish, and does not provide spatial diversity. Habitat above the project is both sufficient in size and quality to help achieve both these essential requirements, if the fish have safe and effective access to and from it. As proposed, the Corps' action would not provide safe or effective passage in either direction, and in fact, would injure and kill large numbers of juvenile and adult Chinook salmon and steelhead. Decreased numbers of PS Chinook salmon would reduce the abundance of SR killer whale's preferred prey. Therefore, the proposed action would pose a significant risk to PS Chinook salmon and PS steelhead abundance and spatial diversity, thereby reducing the abundance of the preferred prey for SR killer whales

### 2.6.1 Puget Sound Chinook Salmon

The PS Chinook ESU is listed as threatened, and rangewide abundance and productivity have decreased in recent years. All extant populations are considered to be at high risk of extirpation. The White River population of PS Chinook salmon is currently at high risk and is one of two populations in the Central/South Sound biogeographical region that must reach a low risk status, along with 9 other populations in the ESU (see Table 2), for the ESU to be considered recovered. Abundance of the White River population has increased since the late 1980s, largely due to hatchery production and retirement of the White River Hydroelectric Project in 2004, which increased flows downstream from the diversion dam. However, essential features of their habitat are, and would continue to be, degraded by the poor performance of fish passage systems at MMD, reducing the potential for survival and recovery.

Continued operation and maintenance of the MMD project as proposed would have small beneficial effects (reduced redd scour) on the White River population and much larger adverse effects (injury and mortality associated with passage). By reducing peak flows, the project would



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benefit incubating eggs and pre-emergent fry in the river reach downstream from the White River diversion, but would also reduce channel complexity, reducing juvenile rearing habitat. While replacing the diversion dam with a modern barrier dam would improve adult upstream migration survival and downstream spawning through emergence success by protecting redds from dewatering effects that are currently necessary to maintain the old dam, we cannot consider those effects in our analysis because the Corps provides no date for completing the new fish barrier structure in its BA. High rates of mortality associated with juvenile passage through MMD's 9-foot-tunnel and the adult passage through the trap and haul facility would continue, and likely worsen as these structures deteriorate. Unsafe and ineffective passage for returning adult and outmigrating juvenile White River Chinook salmon would limit the use of high quality upstream spawning and rearing habitats, thereby constraining the population's abundance and productivity. While the proposed action includes some small beneficial effects on PS Chinook salmon survival, the large negative effects posed by poor upstream and downstream passage that limit PS Chinook salmon productivity, abundance, and spatial diversity means that the proposed action would present risks to the continued existence of the species, and delay or otherwise obstruct their recovery.

To date, various regional parties have implemented numerous measures identified in the recovery plan (Judge 2011). Continued progress in implementing the plan would, over time, help improve the status of the species and its critical habitats. However, the adverse effects of continued human population growth in the region, attendant land use changes, and ongoing climate change will continue to limit the ESU's likelihood of survival and recovery.

Critical habitat in the White River basin has high conservation value. The conservation role of this critical habitat is to support a viable independent population of PS Chinook salmon. As explained above, the White River population must be at low risk of extirpation for this ESU to be considered recovered. Critical habitat for spawning and incubating PS Chinook salmon would be both adversely and beneficially affected by the proposed action. Spawning habitat downstream from the White River diversion dam is abundant, but flood control operations would disrupt sediment transport, adding to substrate embeddedness downstream from MMD, potentially reducing spawning success. However, by reducing peak flows, the proposed action would also reduce the potential for redd scour. Given the strong negative correlation between annual peak flows and salmon year-class strength observed in the Skagit River, we believe the beneficial effect of reducing redd scour would exceed the adverse effects of reduced channel complexity downstream from MMD on PS Chinook spawning habitat. However, the reduction in channel complexity would tend to reduce the amount of juvenile rearing habitat in the river reach downstream from MMD. Migration corridor critical habitats would continue to be poor for migrating juveniles at MMD due to poor survival through the 9 foot tunnel, the primary discharge system for MMD. The White River diversion dam and fish trap would continue to obstruct the migratory corridor by imposing delay, injury and mortality on returning adults. It is unlikely that the proposed action would have any effect on the conservation value of critical habitats in the estuary or near shore marine environments.

In summary, numbers of PS Chinook are decreasing, and a significant number of the White River Chinook salmon (a population essential for survival and recovery of the ESU) would be injured or killed by downstream passage at MMD, and upstream and downstream passage at the White River diversion dam and trap and haul facility. Due to poor passage survival for juveniles and adults, the Chinook's ability to access high quality critical habitat upstream of the project for spawning and rearing would be limited. The effects of the proposed action (adverse), when added to the status of the PS Chinook salmon ESU (high risk of extinction), the environmental baseline (degraded), and cumulative effects (mixed beneficial and adverse), would appreciably reduce the likelihood of survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution. Our determination is based on the following considerations:

- All 22 populations of this ESU are considered at high risk and no populations are currently viable. The status of this ESU is far from the delisting criteria described in our recovery plan.
- The White River population must be at low risk for the ESU to reach recovery.
- The effects of the action will reduce or continue to depress White River population abundance, productivity, and spatial diversity.
- Cumulative effects and climate change are likely to reduce the quality of habitat in the lower White River basin. The habitat in the upper basin is the most capable of contributing to a viable population.

Additionally, the effects of the proposed action (adverse), when added to the environmental baseline (degraded), cumulative effects (mixed beneficial and adverse), and status of critical habitat (degraded), will appreciably reduce the condition and function of critical habitat in the upper and lower White River 5th field watersheds. Our determination is based on the following considerations:

- Both watersheds have high conservation value and support populations that are critical to the survival and recovery of the PS Chinook salmon ESU.
- The quality of critical habitat in the lower basin is fair due to human development, but the quality of critical habitat in the upper basin, above MMD is good, and this habitat has the best chance of supporting a viable population. Due to the effects of the action on upstream and downstream passage, the proposed action forecloses this opportunity.
- Population growth and climate change are likely to reduce the quality of critical habitat in the lower White River basin. The habitat in the upper basin is the most capable of contributing to a viable population
- The proposed action will impair the ability of the affected critical habitat to play its intended conservation role, in this case, supporting a viable population of PS Chinook salmon.

The proposed action impairs the ability of critical habitat in the upper and Lower White River watersheds to play its intended conservation role. Since the White River population of PS Chinook salmon is essential to the recovery of the ESU, this impairment is significant in the context of critical habitat at the designation-scale.

### 2.6.2 Puget Sound Steelhead

The PS steelhead DPS is listed as threatened, and the Puyallup/White River population is at high risk of quasi-extirpation within 25 to 30 years (Ford 2011) due to a declining population trend. Rangewide abundance has decreased in recent years, productivity has declined, and the White River population remains severely depressed. Considering the established biological recovery criteria, we find it very likely that the final recovery plan for this DPS will identify the White River DIP as essential to the recovery of the Central and Southern Cascades MPG and the species as a whole.

Population viability analyses have shown that all three of the MPGs of the PS steelhead DPS are at very low viability (PSSTRT 2013), making the likelihood for extinction moderate to high. Recovery would require highly viable DIPs in all three MPGs. Detailed analysis of population viability has shown that while the viability of the White River DIP is low (0.49), it is the highest among all the DIPs in the Central and Southern Cascades MPG.

Operation and maintenance of the MMD project as proposed would have small beneficial effects on the White River population and larger adverse effects. By reducing peak flows, the project would continue to reduce channel complexity and juvenile rearing habitat downstream from the White River diversion dam. Overall, proposed operations would slightly reduce the quality of steelhead spawning and incubation habitat in the White River downstream from the diversion dam. While replacing the diversion dam would improve adult upstream migration survival and downstream spawning through emergence success by protecting redds from dewatering effects that are currently necessary to maintain the old dam, we cannot consider those effects in our analysis because the Corps provides no date for completing this work in its BA. High rates of mortality associated with juvenile passage through MMD's 9-foot tunnel, and adult passage through the trap and haul facility, would continue, and likely worsen as these structures deteriorate over time. Unsafe and ineffective passage for returning adult and outmigrating juvenile White River steelhead would limit the use of high quality upstream spawning and rearing habitats, thereby constraining the population's abundance and productivity. Overall, the project would contribute to ongoing declines in abundance, productivity and spatial diversity of the species primarily due to high rates of injury and mortality during both upstream and downstream passage. These passage bottlenecks also diminish the value of high quality spawning and rearing habitats upstream of MMD by limiting access to them and by reducing the contribution of juvenile production to the adult population.

Proposed critical habitat for spawning and incubating PS steelhead in the river reach downstream from MMD would be adversely affected by the proposed action. Spawning habitat is abundant in the White River, but flood control operations would disrupt sediment transport (put more sediment into the river when flows are insufficient to keep it moving), adding to substrate embeddedness downstream from MMD, potentially reducing spawning success. The proposed action would continue to modestly reduce spawning and rearing habitats downstream from MMD by reducing channel maintaining and forming peak flows. Safe passage to a significant amount of high quality spawning and rearing habitats upstream of MMD would continue to be obstructed by the poor performance of the trap and haul system. The juvenile migration corridor would be obstructed by the high level of mortality observed at the primary MMD discharge system, the 9 foot tunnel.

To date, various regional parties have implemented numerous measures identified in the PS Chinook salmon recovery plan (Judge 2011). Most of these efforts also benefit PS steelhead and their proposed critical habitats. Continued progress in implementing the plan would, over time, help improve the status of the species and its critical habitats. However, the adverse effects of continued human population growth in the region, attendant land use changes, and ongoing climate change will continue to limit the ESU's likelihood of survival and recovery.

The effects of the proposed action (adverse), when added to the status of the PS steelhead DPS (high risk of extinction), the environmental baseline (degraded), and cumulative effects (mixed beneficial and adverse), would appreciably reduce the likelihood of survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution. Our determination is based on the following considerations:

- This DPS is at moderate to high risk of extinction and none of the MPGs are considered to be viable.
- It very likely that the final recovery plan for this DPS will identify the White River DIP as essential to the recovery of the Central and Southern Cascades MPG and the species as a whole.
- The effects of the action will reduce or continue to depress White River DIP abundance, productivity, and spatial diversity.
- Population growth and climate change are likely to reduce the quality of habitat in the lower White River basin over the life of the action. The habitat in the upper basin is less susceptible to these adverse effects and will remain more capable of contributing to a viable population.

Additionally, the effects of the proposed action (adverse), when added to the environmental baseline (degraded), cumulative effects (mixed beneficial and adverse), and status of critical habitat (degraded), would appreciably reduce the condition and function of proposed critical habitat in the Upper and Lower White River 5th field watersheds. Our determination is based on the following considerations:

- Both watersheds in the action area have been assigned high conservation value ratings and support a population that is likely to be critical to the survival and recovery of the PS steelhead DPS.
- The quality of critical habitat in the lower basin is fair due to human development, but the quality of critical habitat in the upper basin, above MMD is good, and this habitat has the best chance of supporting a viable DIP. Due to the effects of the action on upstream and downstream passage, the proposed action forecloses this opportunity.
- Cumulative effects and climate change are likely to reduce the quality of proposed critical habitat in the lower White River basin. The habitat in the upper basin is the most capable of contributing to a viable DIP
- The proposed action would impair the ability of the affected proposed critical habitat to play its intended conservation role, in this case, supporting a viable population of PS steelhead.

The proposed action would impair the ability of critical habitat in the upper and Lower White River watersheds to meet its intended conservation role. Since the White River population of PS steelhead is very likely to be essential to the recovery of the DPS, this impairment would be significant in the context of critical habitat at the proposed designation-scale.

### 2.6.3 Southern Resident Killer Whales

The SR killer whale population is listed as endangered. The SR killer whale DPS has 82 members and recent estimates of population growth are not sufficient to achieve recovery. Thus, due to the precarious condition of the SR killer whale DPS, our Section 7 analysis must scrutinize even small effects on the fitness of individuals that increase the risk of mortality or decrease the chances of successful reproduction. In this case, we focus on decreasing numbers of an essential prey species, PS Chinook salmon because that is the main adverse effect of the proposed action on SR killer whale

Persuasive scientific information indicates that SR killer whales primarily eat Chinook salmon in inland waters of Washington State and British Columbia (Hanson et al. 2010). Additionally, there is genetic evidence that Chinook salmon from Puget Sound are consumed by SR killer whales (Ford and Ellis 2006). A reduction in prey or a requirement of increased foraging efficiency (catch per unit effort) may have physiological effects on SR killer whales, thereby adversely affecting the conservation value of their critical habitat. In response to fewer or less dense prey patches, SR killer whales would need to expend additional energy to locate and capture available prey. Increased energy expenditure or insufficient prey may result in poor nutrition, which could lead to reproductive or immune effects or, if severe enough, death. A reduction in prey is also likely to work in concert with other threats to produce an adverse effect. For example, insufficient prey could cause whales to rely upon their fat stores, which contain high contaminant levels, impairing reproductive success or compromising immune function, and making them more susceptible to disease.

Over the long term, the proposed action would decrease the abundance and productivity of PS Chinook salmon and increase the risk of their extinction. Reducing the numbers of PS Chinook would reduce their availability as prey and increase the likelihood for local depletions of prey during times when SR killer whale foraging focuses on Chinook salmon. In response, SR killer whales would increase foraging effort or abandon areas in search of more abundant prey. Reducing the availability of Chinook salmon to SR killer whales would reduce the representation of diversity in life histories, resiliency in withstanding stochastic events, and redundancy to ensure there is a margin of safety for SR killer whales to withstand catastrophic events. By reducing the abundance of PS Chinook, an essential prey species, the proposed action would reduce the availability of food, thereby reducing the likelihood that SR killer whales would recover and the conservation value of their critical habitat.

In summary; by reducing the abundance of PS Chinook and increasing their extinction risk, the proposed action would increase the risk of a permanent reduction in prey available to SR killer whales, and increases the likelihood for local depletions of prey in particular locations and times. Appreciably reducing the potential for survival and recovery of PS Chinook salmon would reduce the potential for SR killer whales to survive and recover.

## 2.7 Conclusions

### 2.7.1 Puget Sound Chinook and Puget Sound steelhead

After reviewing the current status of the listed species (moderate to high risk of extinction for PS Chinook and PS steelhead, respectively), the environmental baseline within the action area (degraded), the anticipated effects of the proposed action (small beneficial effects on spawning and incubating fish downstream from the diversion dam, with much larger adverse effects of ineffective and unsafe passage to and from high quality habitat upstream of MMD), and cumulative effects (mixed beneficial and adverse effects), it is NMFS' biological opinion that the proposed action would cause a reduction in the White River populations of PS Chinook salmon and PS steelhead, and would therefore jeopardize the continued existence of PS Chinook salmon and PS steelhead and would destroy or adversely modify PS Chinook salmon designated critical habitat and PS steelhead proposed critical habitat.

This Opinion includes a conference opinion on PS steelhead critical habitat, which has been proposed, but has not yet been designated. The Corps may ask NMFS to adopt the conference opinion as a biological opinion when critical habitat for PS steelhead is designated. The request must be in writing. If we review the proposed action, including your implementation of the RPA, and find there have been no significant changes to the action, as modified by the RPA, that would alter the contents of the opinion and no significant new information has been developed (including during the rulemaking process), we may adopt the conference opinion as the biological opinion on the proposed action and no further consultation would be necessary.

### 2.7.2 Southern Resident Killer Whales

After reviewing the current status of SR killer whales (endangered with declining abundance), the environmental baseline within the action area (degraded), the anticipated effects of the proposed action (reduced production of essential prey species, PS Chinook salmon), and cumulative effects, it is NMFS' biological opinion that the proposed action would jeopardize the continued existence of SR killer whales by reducing their prey base and reducing the likelihood of survival and recovery, and would destroy or adversely modify their critical habitat.

## 2.8 Reasonable and Prudent Alternative

"Reasonable and prudent alternatives" (RPA) refer to alternative actions identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, that are economically and technologically feasible, and that would avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat (50 CFR 402.14).

NMFS determined, in this biological opinion, that the Corps' proposed action would jeopardize the continued existence of PS Chinook salmon, PS steelhead, and SR killer whales, and cause destruction or adverse modification of PS Chinook salmon and SR killer whale critical habitats. Therefore, in accordance with our regulations at 50 CFR 402.14, we are providing to the Corps, the following RPA that would avoid the likelihood of jeopardizing the continued existence of PS

Chinook and PS steelhead; and avoid destruction and adverse modification of designated critical habitat. The RPA we provide below must be implemented in addition to the measures in the proposed action, and is not meant to replace those measures. On its own, the RPA would not avoid jeopardy and adverse modification of critical habitat. It is essential that the Corps implements all the measures in the proposed action as well as the measures we provide in the RPA. Therefore, in order to avoid jeopardy, and destruction or adverse modification of critical habitat, the Corps needs to implement all the measures they provide in their proposed action, and the measures NMFS is providing in this RPA, including the accompanying Appendix A.

The RPA measure regarding design, construction and operation of a new trap and haul facility; and design and construction of a new fish barrier structure to replace the White River diversion dam, includes a schedule for this work, and annual check-ins to ensure that progress complies with the schedule and is on track for completion by the dates specified in the RPA. The Corps must meet these RPA deadlines to ensure that its actions do not violate the ESA's prohibitions against jeopardy and adverse modification.

As explained in the Integration and Synthesis section of this Opinion, PS Chinook salmon and PS steelhead numbers are declining, and the survival with a likelihood of recovery of the White River populations of both species is an essential component of ensuring that there will not be an appreciable reduction in the survival and recovery of the ESU and DPS. . The proposed action would cause substantial injury and death to both species from unsafe and ineffective passage in both directions. The proposed action would also prevent numbers of both populations from increasing by limiting their ability to use high quality upstream spawning and rearing habitat. Safe and effective passage and use of the upstream habitat are needed to allow survival and support recovery. Decreasing the harm to both species, and increasing their ability to reproduce and increase their numbers is essential to avoiding jeopardy for both PS Chinook salmon and PS steelhead, and is also essential to avoid jeopardizing SR killer whales. This RPA would also avoid adversely modifying critical habitat by restoring the migration corridor by providing safe and effective passage through the dam for PS Chinook salmon and steelhead, and by increasing the SR killer whale prey base.

Avoiding jeopardy and adverse modification of critical habitat requires substantial improvement in passage survival for migrating adults and juveniles. With observed adult pre-spawn mortality around 20% for Chinook salmon arriving during biannual pink salmon runs, and data indicating that only 18% of juveniles passing through MMD's 9-foot tunnel survive to be detected at downstream receivers, fish passage at the MMD project is presently limiting the abundance and productivity of White River Chinook salmon and steelhead and would continue to do so under the Corps' proposed action. It would also improve the migratory corridor component of their critical habitat.

Upstream adult salmon passage survival rates through properly-functioning fish passage facilities at other projects in the Pacific Northwest are capable of achieving 98% survival, or higher (e.g. Federal Columbia River Power System dams). Downstream juvenile passage survival rates through properly functioning fish passage facilities commonly achieve 95% survival, or higher (e.g. Federal Columbia River Power System dams). These survival rates are technically and practically feasible at the MMD Project based on examples of fish passage facilities at similar projects throughout the Pacific Northwest region. If these survival rates are achieved, we are confident that an appreciable reduction in survival and recovery would be avoided. It would also improve the migratory corridor component of their critical habitat. High passage survival is essential due to the low abundance of the White River populations, increasing the potential for extirpation. As populations decline to well below a habitat's carrying capacity, the potential for infrequent adverse events to extirpate the species increases. To avoid jeopardy, it is essential to both increase abundance and productivity, and to maintain or expand spatial diversity. In this case, to avoid an appreciable reduction in survival and recovery, nearly all the adults that have survived the numerous hazards in prior life stages to return to their natal stream, then have the opportunity to complete their life cycle by spawning in in the available high quality upstream of MMD. It is equally important that nearly all juveniles that survive to become smolts, survive their migration downstream, and contribute to an increased number of returning adults (Generally, less than 10 percent of smolts survive to maturity. However, even though most die prior to maturity, the more smolts there are, all things being equal, the more adults there would be).

For these reasons, safe and effective passage is a central focus of this RPA. The RPA provides short-term and longer-term measures to accomplish this. The longer-term measures will avoid jeopardy and adverse modification of critical habitat over the long term, but until they are completed, the short term measures would be sufficient to avoid jeopardy and adverse modification of critical habitat.

NMFS provided a draft biological opinion to the Corps on October 31, 2013, including a draft RPA, as provided in our regulations at 50 CFR 402.14(g)(5). NMFS and the Corps worked together to modify the RPA in such a way that includes actions that are within the Corps' authority to implement, are consistent with the purposes of the proposed action, are economically and technically feasible, and that NMFS' believes are essential to avoiding jeopardy and adverse modification of critical habitat. This RPA reflects the result of that work.

Improving downstream passage survival for outmigrating juveniles would be accomplished by immediately stopping use of the 9 foot tunnel that kills over 80% of downstream migrating juveniles. The short-term repair of diversion dam apron would reduce injury of juveniles passing over the diversion dam and complete replacement of the diversion dam with a well-designed fish barrier would further improve juvenile passage survival. Thus, these two measures work in tandem for safe and effective downstream passage.

Upstream passage would be improved by designing, constructing, and operating a new trap and haul facility, in concert with a new and safe fish barrier structure. Unsafe and ineffective upstream passage is one of the major factors causing jeopardy and adverse modification of critical habitat, and the Corps needs to remedy this as quickly as possible. Based on information from the Corps, the fastest the Corps can feasibly accomplish this is by December 2020. Therefore, the RPA deadline for completion of the new upstream passage facility that includes both the new trap and haul facility and the new diversion dam, is 2020.

The Corps must implement all RPA actions specified below to avoid jeopardy and adverse modification of critical habitat. These measures address the delay, injury and mortality caused by the upstream and downstream passage available to PS Chinook salmon and PS steelhead under the proposed action. It includes longer-term measures that will provide assurance that the Corps is avoiding jeopardy and adverse modification of critical habitat by requiring design, construction and operation of a new upstream passage facility, including a new trap and haul facility and a new fish barrier structure by a date certain, with certain milestones that would assure NMFS that the Corps will meet the completion date specified in the RPA. It includes short-term measures that will provide assurance that the there is no appreciable reduction in survival and recovery, or adverse modification of critical habitat until the longer term measures are completed and performing as designed. These measures are to immediately begin using the 23 foot tunnel, and smoothing the surface of the diversion dam. The Corps needs to conduct all the measures in the proposed action provided in its 2013 BA, in addition to the following actions.

### 2.8.1 Downstream Passage

#### *2.8.1.1 RPA Action Item 1.*

Starting in 2015, operate the project in a manner that achieves a 95% smolt passage survival rate. To accomplish this, the Corps will maximize use of the 23-foot tunnel as the primary discharge system and use the 9-foot only when absolutely necessary from March 1 through June 30 each year. Necessary operation of the 9-foot tunnel includes periodic openings to flush bedload to keep it from building up enough to enter the 23-foot tunnel and also to minimize ecological and water quality impacts from sediment flushed downstream (in terms of duration and magnitude) when opening the 9-foot tunnel after closure. The Corps will operate the tunnels adaptively in real time in response to flow conditions and bedload accumulation, as well as over the longer term in response to smolt passage study results and observations of tunnel condition.

Each year, management of the tunnels between March 1 and June 30 will be guided by a flow management and monitoring plan that meets the 95% smolt survival passage. The Corps will complete the annual plan by February 10 each year, in collaboration with NMFS and with NMFS' concurrence. The plan will provide preset triggers and in-season communication guiding real-time management of spring operations. The Corps will work with NMFS to update the plan annually in response to new information. The Corps will provide an annual report to NMFS by January 31 of each year that describes operations during the previous spring, observations regarding sedimentation and turbidity near MMD, and results of any studies pertaining to tunnel operations. Such report will also be provided to the Tribal and state fishery co-managers and the public when final.

The Corps will work collaboratively with NMFS on the design of smolt survival studies, to better characterize effects of the range of tunnel operational scenarios on fish passage. The Corps will conduct the study, and the results will be used by the Corps and NMFS to inform operational decisions on tunnel operations. The Corps will obtain NMFS concurrence on the interpretation of the results and actions needed as a result of the studies.

*Rationale:* Lack of safe and effective downstream passage is one of the major causes of jeopardy and adverse modification due to the large number of juvenile fish killed going downstream through the MMD's 9' tunnel. The ability to produce fish in high quality upstream spawning and rearing habitat, and to safely pass them downstream, will contribute to an overall



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increase in population numbers for White River Chinook salmon and steelhead. Therefore, providing safe and effective downstream passage for juveniles is essential to avoiding jeopardy for all three listed species, PS Chinook salmon, PS steelhead, and SR killer whale. By improving the passage survival for PS Chinook salmon and PS steelhead this measure would improve the migratory corridor component of their critical habitat and by increasing the production of PS Chinook it would improve the prey base component of SR killer whale critical habitat.

The best available scientific information on juvenile fish passage at MMD (Corps 2013c, R2 Resources 2013) shows that fish passing through the lower 9-foot outlet at MMD suffer very high rates of mortality (~82% mortality). Because a higher rate of survival (essentially 100%) was found for the upper 23-foot diameter tunnel outlet (Corps 2013c, R2 Resources 2013), operations to ensure passage through this outlet would substantially reduce the risks of injury and death to downstream migrating juveniles of both PS Chinook salmon and PS steelhead. This measure would increase both PS Chinook salmon and PS steelhead survival and abundance by avoiding the proposed action's primary cause of smolt mortality; dam passage via the 9-foot tunnel.

For the 2013 study, test fish (juvenile steelhead smolts) were acoustically tagged and released. Tag detectors were set up at several locations downstream from MMD and the diversion dam. Two groups of fish were released for each test; a control group, released immediately downstream from the dam, and a test group, released upstream of the dam and made to pass through the dam via each of the tunnels. The ratios of tagged test fish and tagged control group fish that passed downstream detectors were used to estimate the survival differential caused by passage through MMD (percent mortality = 1 – percent survival). Detection rates were nearly identical between groups when the 23-foot tunnel was used, but losses of test group fish were extremely high when the 9-foot tunnel was used to pass smolts downstream.

A small fraction (<5%) of the annual juvenile outmigration would occur outside of the March through June window and would likely pass through the 9-foot tunnel and suffer high rates of mortality. This loss would be insignificant relative to the total population of smolts.

NMFS cannot quantify the numbers of returning adults when we substantially increase the numbers of juveniles surviving downstream. But we can predict that productivity will substantially increase due to such an increase in numbers surviving past MMD.

Because there are some risks to using the 23' tunnel (see next paragraph), RPA Action Item 1 also requires additional investigation of juvenile passage survival to identify hazards due to use of the 9' tunnel that could be remedied. There will be take associated with this study because test fish will be run through the 9 foot tunnel that causes high levels of take. The maximum number of juveniles will be 1,000, and will have almost no effect because it is extremely small relative to the total number of juveniles produced in the system. Hence, if the Corps fixes hazards in the 9-foot to provide a 95% passage survival rate with its increased use, the Corps may be able to use the 9' tunnel for juvenile passage, after receiving NMFS' concurrence on use of the 9' tunnel.

Modifying project operations to minimize passage through the 9-foot tunnel could result in other effects that may adversely affect juvenile salmon and steelhead. By closing the 9-foot tunnel, a small pool would be formed that would trap incoming sediments. To maintain safe project operation, those accumulated would occasionally need to be released. Such sediment releases would adversely affect incubating steelhead eggs and pre-emergent fry in the river reach downstream. This effect is expected to be quite small in comparison to the large increase in juvenile survival. Because these study results are unexpected and operations designed to mitigate these low passage survival effects could carry additional risks to smolt survival, NMFS is requiring a more expansive study, under hydrologic and operating conditions likely to occur during smolt outmigrations that would provide greater certainty to managing juvenile passage through the dam to achieve the 95% passage survival standard.

### 2.8.2 Upstream Passage

#### *2.8.2.1 RPA Action Item 2:*

The Corps will perform interim repairs to the existing barrier apron at the White River diversion dam in a manner that is structurally sound, provides a reasonably durable solution, and addresses the conditions that harm migrating salmonids. Repair of the apron must include working with CWA and coordinating with NMFS on the design of the apron repair. The Corps will repair the apron in whole or part as quickly as possible, but the work must be completed no later than August 31, 2015.

*Rationale*: This measure would increase PS Chinook salmon and PS steelhead survival by reducing the hazards to upstream migrating adults posed by the damaged dam apron. About 18% of adult PS Chinook salmon arriving at the White River diversion fish trap exhibit head wounds and other injuries for which voids in the apron timbers and exposed rebar and spikes in the approach apron are the most likely causes. Mitigating this effect by filling voids, grinding down, or cutting off, the metal protrusions or otherwise modifying exposed metal is an easily performed measure that the Corps has already begun (summer of 2014), and is likely to substantially reduce the incidence of injury. This action would also likely improve migrating smolt survival when passing the diversion dam. The incidence of injury and death to juveniles that pass over the diversion dam is unknown, but all juveniles produced upstream of MMD would have to pass over this dam and the hazardous condition of dam apron suggest that it would injure or kill some of the passing juveniles. This measure can be accomplished very quickly (less than one year), and is one of the short term measures that are essential to avoid jeopardizing the species and adversely modifying their critical habitat in the near term while the longer term measures are being designed and constructed.

#### *2.8.2.2 RPA Action Item 3:*

To accomplish safe, timely, and effective upstream fish passage, the Corps will design, construct and operate a new fish barrier, and trapping, sorting, and passage facilities to replace the White River diversion dam and current trap and haul facility. The Corps will begin work immediately to design the new fish passage facilities that will be operational by December 2020.

To accomplish this RPA measure, the Corps' commitment has the following elements:

- To build and operate a fish sorting and trap and haul facility that achieves the adult performance standards for ESA-listed species (95% attraction and 98% passage survival), and is mindful of cost;
- Selection of a preliminary and final preferred design that meets the RPA performance standards and design criteria, with NMFS's concurrence;
- The facility will enable accurate adult fish counts; enable coarse-level sorting to separate ESA-listed species from non-listed species, and by tag presence, and accommodate co-manager sorting and sampling needs identified in the design process; monitoring of 95% attraction and 98% survival for adult ESA-listed fish through the fish passage facility and broodstock collection for the MIT hatchery;
- Develop and complete design, and construction as per simplified schedule, as part of a collaborative design team (Federal agencies and co-managers); and
- To collaborate with NMFS, and with the co-managers on design and evaluation effort to develop the preliminary design that will be used to estimate cost, and collaboration will be continued to completion of the project.

The new facilities will be designed to accommodate a single-season salmon run that includes pink salmon, of 1.25 million fish, and up to 60,000 fish to be passed upstream in one day, in accordance with the design criteria and process presented in Appendix A to this Opinion and RPA. The design will be developed collaboratively with NMFS and the other parties provided in Appendix A, if they chose to participate, receive NMFS' concurrence, and must be completed in a timely manner to ensure construction is complete and operational by December 2020. The Corps will begin operation of the new facility as soon as it is completed, but no later than December 31, 2020.

The new facility must meet at least a 95% attraction rate into the facility and 98% survival rate through the facility (from entrance through upstream release) for passing adult PS Chinook and PS steelhead. The Corps will monitor the survival rate and use adaptive management measures, as needed, to modify the facility (including its operation) to meet the 95% attraction and 98% survival performance standards. The rate of passage will be sufficient to avoid holding fish for more than 24 hours. (The limited exception to this requirement is that when there are very few ESA-listed fish (e.g. less than 5) entering the trap over a weekend, the Corps is not required to move the fish over a weekend and may hold fish up to 60 hours as long as conditions in the trap are conducive to safely holding fish up to 60 hours (e.g. suitable temperatures and no crowding). The Corps is responsible for coarse sorting fish to separate listed from non-listed fish, and identifying tagged fish. (The Corps is not responsible for sorting fish beyond separating listed from non-listed fish and identifying Passive Integrated Transponder (PIT) -tagged and coded wire tagged PS Chinook salmon and PS steelhead). The facility will include the means for sampling marked fish and separating PS Chinook salmon for MIT hatchery broodstock use. Additionally, the design and Corps' operation of the new trap and fish barrier structure will facilitate the ESA broodstock collection and fishery management and evaluation needs of the Muckleshoot Indian Tribe's White River hatchery.

The basic elements of the new facility will include, but are not limited to: barrier structure, fishway entrances (one or two banks), entrance pools, auxiliary water supply system, fish sorting and holding facilities, loading facilities, trucks, construction staging areas and best management practices, and adult release location(s).

The engineering design team (see Appendix A) will work collaboratively to decide whether the facility needs entrances on both sides of the White River, or just one side, a main entrance on one side and a secondary one on the other side, or some other variation. The team will work collaboratively to make a decision by spring 2015, with NMFS's concurrence in the design decision and preliminary design (per the following paragraph). This design and decision process will not delay completion of the preliminary design. Appendix A provides more details on the design and the design team. It is part of the RPA and the Corps will adhere to it as part of this RPA. Some of the technical issues that need to be resolved include but are not limited to: number and location of fishway entrances , the hydraulic capacity of each fishway entrance, sediment management, and the scale of sorting facilities needed to accommodate fisheries management and hatchery needs.

To ensure that the evaluation of the effects of the construction and operation of these facilities envelop the anticipated range of options around the still-open issues pertaining to design of the entrances and to avoid the necessity of reopening this consultation, this evaluation will assume that the passage facility will have entrances for fish collection on both sides of the river. Once the design team identifies a design concept that meets the 95 % and 98% criteria, as well as the additional design criteria in Appendix A, and NMFS and the Corps concur with the design; then that design concept will be in compliance with the RPA.

To demonstrate that the Corps' new adult fish barrier structure and trap and haul facilities meet the performance and design criteria, the Corps will design a performance testing program in collaboration with NMFs, and with NMFS' concurrence. The Corps will then conduct the performance test(s). If the facilities cannot meet the design criteria of safely passing 60,000 fish/day, moving all PS Chinook salmon and PS steelhead to the release site upstream of MMD within 24 hours of trap entry, or the 95% attraction and 98% passage survival criteria, then the Corps will collaborate with NMFS to determine the appropriate means to modify its operations or facilities to meet the criteria. The Corps will then make those modifications.

By December 2020, the Corps will complete construction of the new passage facilities, and the facilities will be operational. By January 31 each year until project completion, the Corps will provide a progress report to NMFS documenting progress and showing that the following milestones (both sets of milestones listed below) for RPA measure 3 are met:

- Complete Final Decision Document (30% preliminary design) June 2015 (for FY 17 budget consideration)
- Construction Phase Start - October 2016

These milestones are intended to serve a planning function to measure progress in achieving the overall objective of commencing operations by no later than December 2020. Failure to meet any one of these proposed milestones is not intended itself to be cause to require reinitiation of consultation so long as the overall objective remains in place.

Additional dates that the Corps should meet to stay on schedule (e.g. 60, 90, and 100% designs) will be developed and included in the Corps' Final Decision Document to be issued by June 2015.

*Rationale:* Poor upstream passage, caused by delay, injury and mortality, is one of the major causes of jeopardy for listed species we addressed in the opinion. There are two main causes, the current trap and haul facility, and the barrier dam. The listed salmon and steelhead need to be able to safely access high quality upstream spawning and rearing habitat in order to successfully reproduce in sufficient numbers to ensure population survival with a likelihood of recovery. Replacing both the trap and haul facility and the fish barrier structure is therefore essential to avoiding jeopardy and adverse modification of critical habitat for the two listed anadromous fish species and SR killer whale.

The existing adult collection system causes high rates of injury and mortality in the collection and handling of listed fish. Because the trap lacks sufficient capacity to handle the numbers of fish returning to the dam, and lacks up-to-date fish handling and sorting facilities, fish are delayed in finding the fishway entrance, incur injuries as they attempt to ascend the dam and trap and incur high levels of stress once they reach the trap. During odd-numbered years, when very large numbers of pink salmon arrive at the trap at the same time as PS Chinook salmon, congestion at White River diversion dam and trapping and handling results in delay, injury and mortality of large numbers of PS Chinook salmon. These effects would be reduced by repair of the apron and replacement of the dam, but in the short term, a lesser level of injury and mortality would continue due to the inadequate performance of the fishway and trap and delay (and its attendant harms) would continue due to the limited capacity of the existing trap and haul system. Modern trap-and-haul facilities routinely achieve 98% upstream passage survival, while passage survival at the existing adult passage system is currently less than 80% and injuries incurred at the existing system causes substantial additional pre-spawning mortality to fish that reach the trap.

Due to the small numbers of fish that survive the existing trap and haul system in good condition, not enough fish are able to be placed upstream of the dam and survive to spawn to allow the population to increase in numbers. There is good spawning and rearing habitat upstream of the dam that is currently under-seeded. Improving passage survival would allow the populations of both PS Chinook salmon and PS steelhead to increase in abundance and productivity, increasing their likelihood of survival and recovery. By improving fish passage survival this measure would also improve the migration corridor component of their critical habitat. The new barrier and trap are expected to increase passage survival by about 25% (from the current 70% to 80% survival rate of PS Chinook to 95% survival), and to reduce the current high rate of pre-spawning mortality. In combination with the nearly five-fold improvement in juvenile survival provided by RPA Action Item 1, it is likely that abundance and productivity (the number of recruits per spawner) would increase substantially. It is not possible to quantify such improvements because there is an array of unpredictable environmental variables that affect ocean survival.

As stated above, poor upstream passage, caused by delay, injury, and mortality, is one of the major causes of jeopardy and adverse modification of critical habitat. The existing diversion dam causes significant harm on its own, but is part of the existing upstream passage system, and it is essential to replace the diversion dam with a new, safe and effective fish barrier structure as well as replacing the fishway, trap, and associated facilities to increase adult passage success and survival and avoid adverse modification of critical habitat.

This measure provides for replacement of the diversion dam with a modern fish barrier structure by a date certain, thereby limiting the time that adult passage hazards posed by the existing White River diversion dam would continue. The Corps' BA proposes to replace the existing structure, but does not provide a completion date for this important measure. The existing dam requires substantial maintenance work most years, requiring the Corps to reduce flows for worker safety. Such flow reductions are harsh on fish and could be avoided by a more durable structure. The longer the existing dam remains in service, the larger the survival risk imposed. Timely replacement of these facilities is important to species survival and recovery and the conservation value of designated critical habitat. Because recent population trends for White River PS Chinook salmon and PS steelhead are negative and critical habitat is degraded, it is important to remove roadblocks to survival and recovery as quickly and effectively as possible. Even though the benefits of this action item would not occur for six years (January 1, 2021), RPA Action Items 1 and 2 would provide immediate improvements sufficient to ensure that there is no appreciable reduction in survival and recovery or adverse modification of critical habitat in the interim, as explained in detail below in our analysis of the effects of the RPA, section 2.8.3.

Safe and effective passage to spawning and rearing habitats upstream of MMD is needed to ensure that the White River populations of PS Chinook salmon and PS steelhead become and remain viable. Improving passage survival would allow these populations to increase in abundance and productivity, increasing their likelihood of survival and recovery and avoiding modification of their critical habitat.

### 2.8.3 Analysis of the Effects of the RPA Measures and Their Ability to Avoid Jeopardy and Destruction and Adverse Modification of Critical Habitat

This RPA ensures the Corps' proposed action will avoid the likelihood of jeopardizing the continued existence of PS Chinook and PS steelhead and SR killer whales, as well as the likelihood of destruction or adverse modification of their critical habitat.

The primary adverse effect of the proposed action on PS Chinook salmon and PS steelhead survival and potential for recovery is the low level of passage survival. Poor passage survival for PS Chinook salmon at the project also reduces the abundance of SR killer whale's preferred prey. Therefore, this RPA focuses on improving passage survival at the project.

Implementing this RPA would greatly reduce the level of delay, injury, and mortality to ESA-listed fish migrating through the White River that would otherwise occur under the proposed action. The greatly reduced mortality and injury rates would allow for increased survival for both PS Chinook and PS steelhead. Increasing survival rates of the White River population of PS Chinook salmon would also improve the potential for recovery of the ESU because the White



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River population is essential for recovery of this ESU. Because PS Chinook salmon are a significant part of the prey base for SR killer whale, the higher PS Chinook salmon survival rates would allow for continued survival of the killer whales, with a potential for their recovery. The high survival rates that would be achieved ensure that there would be no appreciable reduction in the likelihood of survival and recovery or adverse modification of critical habitat of PS Chinook, PS steelhead, or SR killer whales.

Similarly, increasing survival rates of the White River population of PS steelhead would also improve the potential for recovery of the PS steelhead DPS because the White River population is essential for their recovery.

### *2.8.3.1 Effects of RPA Action Item 1*

The extraordinarily low level of juvenile outmigrant survival when passed through the 9-foot tunnel (~18%) is a large project effect on the survival and recovery of both PS Chinook salmon and PS steelhead in the White River. Action Item 1 greatly reduces the high level of juvenile mortality by requiring the Corps to achieve a 95% juvenile passage survival rate, meaning that almost five times as many juvenile salmon and steelhead would survive passage through the project. This action is important because it will result in a substantial increase in numbers of juveniles that will have the effect of increasing the numbers of returning adults.

One of the important factors in understanding why passage of juveniles from above MMD is so important to increasing productivity is that 60% of total salmon and steelhead production takes place upstream of MMD. Therefore downstream passage from this upstream spawning and rearing habitat would improve survival, and would substantially increase the abundance and productivity of the White River populations of PS Chinook and PS steelhead. The ability of both species to spawn and rear in this upstream habitat is also important because it is of higher quality than the habitat downstream of MMD. Therefore, more fish would be produced from the upstream habitat, contributing to the overall numbers of the White River populations.

Another important aspect of increasing the numbers of juvenile White River Chinook salmon and steelhead surviving downstream passage at MMD is the overall increase in numbers of fish in the population. This means that more adults will be returning to spawn in future years, increasing the abundance of the populations.

This improvement in numbers of juveniles would be accomplished by seasonally (March through June) discharging most (~94%) of the water inflowing to the project through the upper, 23-foot tunnel, which has been shown to provide safe passage (R2 Resources 2013). This measure would be implemented immediately, with concurrent juvenile passage survival benefits, resulting in subsequent improvements in adult spawner abundance within 2 (steelhead) to 3 (Chinook salmon) years. By substantially increasing the fraction of juveniles produced in the upper White River watershed that would survive dam passage, this measure would increase the productivity (number of returning spawners from the prior generation of spawners, also termed recruits per spawner, or R/S) of the White River populations of PS Chinook salmon and PS steelhead. It is not currently possible to quantify these improvements in abundance and productivity, but given the approximate 5-fold increase in juvenile passage survival, the scale of improvement is likely to be substantial.

Not all juveniles would pass during the peak outmigration season (March 1 through June 30). The Corps would return the project to normal operations outside of this window and migrating juveniles passing MMD would then pass through the 9-foot tunnel. Based on extensive smolt surveys elsewhere in the Puget Sound region, we expect that less than 5% of the annual outmigration would occur outside of the March 1 – June 30 time frame, and would continue to be exposed to this hazard (Zimmerman et al. 2010). We therefore anticipate that at least 95% of migrating juveniles would survive MMD passage under this RPA, which is an essential part of ensuring survival and is consistent with our recovery goals.

In conducting studies to improve our understanding of juvenile passage survival, some juvenile PS Chinook salmon and/or PS steelhead would be used as test subject. We anticipate that up to 1000 juveniles could be used to conduct such studies and many would be killed by the tests.

When the Corps implements this measure, it will be operating in such a way that sediment could accumulate and the 9-foot tunnel would need to be operated to remain in working order, sending sediment downstream. This would add to the frequency that such sediment releases would occur due to flood damage reduction operations. The Corps has experienced a maximum of 12 such releases per year over the past 15 years (Lewis 2014). We anticipate that RPA Action Item 1 would increase this number by no more than 5 additional events per year, resulting in a maximum of 17 sediment releases per year. This sediment could harm incubating eggs and fry by suffocating them. However, this adverse effect is minor relative to the substantial benefits of increasing juvenile survival from 18% to 95%. This potential effect would only affect PS steelhead redds that would have incubating eggs and pre-emergent fry in redds at this time (see Section 2.3.2, Spawning Habitat). PS Chinook salmon would be unaffected because no active redds would exist at this time.

The Corps must begin implementing RPA Action Item 1 in time for the next juvenile outmigration in the spring of 2015. Therefore, this is a measure that would immediately provide a substantial improvement to juvenile survival. It would also enhance critical habitat conditions by improving the migratory corridor PCE that would be adversely modified by the proposed action.

This action would provide the safe and effective downstream passage necessary to support survival and recovery of both PS Chinook salmon and PS steelhead and to avoid adverse modification of their critical habitat.

#### *2.8.3.2 Effects of RPA Action Item 2*

Under the Corps' proposed action the White River diversion dam would continue to provide the fish barrier function needed to direct fish into the Corps' trap until it was replaced by a modern fish barrier structure. The existing diversion dam presents numerous hazards to migrating salmon and steelhead. The dam approach apron is a wooden structure that has worn substantially over time, creating broken timbers and voids, and exposing large metal staples that have broken,



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exposing sharp points. Rebar used to anchor the apron has also been exposed. Further, the dilapidated nature of the apron has disrupted the desired uniform flow, thereby attracting fish to impassible and hazardous areas. Harm caused by the decrepit apron is that adults are injured by hitting their heads against it, and getting impaled on the wood and exposed rebar. Chinook salmon and steelhead both exhibit wounds that get infected, causing their death before passing upstream, or decreasing their ability to survive to spawn.

Because these injuries and deaths attributable to the decrepit nature of the apron are a primary contributor to the low adult fish passage survival observed at the project, also a clear indication of the proposed action's adverse modification of critical habitat, RPA Action Item 2 directs the Corps to repair/replace the dam's apron by the end of August 2015.

By replacing the dam apron, about half of the injuries and mortalities to adult migrants that would occur under the proposed action, would be avoided. As explained in the effects analysis, about 20% of adults are killed or injured at the dam apron. Replacing the dam apron should cut the injury and mortality by half, to about 10% because the new smooth apron would remove all the hazards. This would increase the numbers of adults, particularly PS Chinook salmon adults that would be able to pass upstream. By reducing the number of fish injured by the approach apron, fewer transported fish would succumb to their injuries prior to spawning. Consequently, this action would improve both the abundance of spawners and their productivity to a level that would support our conclusion that implementation of the RPA would avoid an appreciable reduction in likelihood of survival and recovery and avoid adversely modifying critical habitat.

Completing this RPA measure would likely require temporary dewatering of portions of the channel. The Corps has previously facilitated repairs at the diversion dam by shunting most river flow to the right bank, or through CWA's Lake Tapps flume. To the extent that water would be shunted down the flume, most would return to the river via the juvenile fish return system, about one mile downstream from the diversion dam. To minimize the adverse effects of such operations, the Corps would conduct turbidity monitoring and fish rescue operations. We anticipate small, temporary, adverse effects from this action (primarily entrapment and stranding) and substantial long-term benefits to fish passage survival from implementation of this RPA action item.

#### *2.8.3.3 Effects of RPA Action Item 3*

RPA Action Item 3 improves upstream adult Chinook and steelhead passage survival by requiring the Corps to both replace the White River diversion dam with a modern fish barrier structure, designed expressly for that purpose, and to replace the existing fishway and trap. Hazards at the existing diversion dam are discussed in Section 2.4.2.4. Replacing the diversion dam with a modern fish barrier would avoid all of those effects, including the need for frequent (~annual) flow reductions and channel dewaterings needed to facilitate dam repairs. The poor condition of the dam and approach apron results in poor fish attraction to the existing fishway and trap, causing fish to seek routes of passage where none exists and leading them into hazardous areas where they are injured and killed. Fish unable to locate the fishway entrance are delayed and substantial delay has been shown to reduce survival and increase straying rates.

A modern fish barrier would substantially reduce injury and mortality associated with the existing passage system and would protect the conservation value of critical habitat. An effective fish barrier would effectively discourage fish from attempting to ascend impassible portions of the structure where they might injure themselves and would instead attract them to the fishway that would safely lead them to the trap and haul system. This is important because the numbers of healthy adults would increase as a result, allowing more adults to pass upstream to the spawning and rearing habitat, increasing their likelihood of surviving to spawn, thereby increasing overall productivity. More spawning adults upstream also means that there will be an improvement in the number of eggs and juveniles in the population, increasing the abundance for both populations to levels that would support the ultimate conclusion that the RPA avoids jeopardy and adverse modification of critical habitat.

The existing trap is antiquated and unable to safely handle the current number of adults trying to go upstream to spawn. To transfer fish from the trap to the haul truck, fish must be hand netted, lifted clear of the water, examined for marks and tags, and handed up to the truck. These effects are compounded when large numbers of pink salmon are present, and it is virtually impossible for workers to keep up with the rate of fish entering the trap, resulting in delay and crowding. All of these factors add to the high rates of stress, injury, and mortality observed in the system. A new facility would allow water to water transfers which would substantially decrease the stress associated with current handling approaches. The new fish trap would minimize handling and keep the fish in water from their entry to the trap to the haul truck, greatly reducing the incidence of stress, injury, and mortality. By reducing handling and stress fish reproductive success would be enhanced, increasing abundance and productivity. Additionally, increasing the ability for the fish to spawn and rear upstream increases their spatial diversity.

The new facility would be able to safely handle an increased number of adults that arrive at the diversion structure. It would be able to handle up to 60,000 fish per day, a number that includes pink salmon as well as Chinook salmon and steelhead. This is a sizeable increase over the current facility, and would benefit both listed species by allowing them to pass when they reach the structure instead of being unnecessarily delayed. Both listed species will have more energy to enhancing their chances of surviving to spawn successfully. It also benefits listed fish by providing enough space to prevent crowding while in the facility as well as when they are transported in trucks to the upstream drop-off location. Critical habitat also benefits by improving the migration corridor for PS Chinook salmon and PS steelhead and by improving the prey base for SR killer whales.

The new facility will meet the 95% attraction criteria, benefitting listed fish by ensuring that high numbers of adults will easily locate the fish passage facilities to enable safe and timely upstream transport. The facility will also meet the 98% passage survival criteria, benefitting listed fish by ensuring that almost all will safely pass through the new facility. The combination of both of these performance criteria, along with the ability to handle up to 60,000 fish per day, means that the new facility will allow roughly the same number of adults to pass upstream as if there was no dam present. As a result, the number of adults in the population will expand, increasing abundance and productivity, supporting survival and recovery and the conservation value of critical habitat.

Further, the existing system has no integrated system for fish monitoring. That is, identifying marked and tagged fish for management and research purposes was not a part of the existing trap's design, forcing such activities to be done by hand, requiring out-of-water handling that stresses fish. The new facility will provide a means for keeping the fish in the water while tagging and marking them. This minimizes stress while allowing these important activities to be accomplished. The new system will also provide facilities for safely holding fish. These new holding facilities will allow co-managers and the Corps to apply fish management objectives, such as ensuring that certain ratios or numbers of marked or tagged fish be directed to hatchery broodstock, or be delivered to the upstream release site. Hence, the new trap and associated sorting and holding facilities would not only reduce the stress, injury, and mortality associated with the existing system, it would facilitate modern fish management strategies aimed at species recovery. Hence, this RPA action item would not only achieve a 95% rate of attraction and a 98% rate of passage survival, a substantial improvement over the current 70% attraction and survival rate, it would further fish management activities aimed at recovering the White River populations of PS Chinook salmon and PS steelhead.

By reducing stress, injury, and mortality to upstream migrating adults, this RPA action item would further increase abundance and productivity of both PS Chinook salmon and PS steelhead and the conservation value of their critical habitat. The improved condition of collected fish would also reduce the incidence of pre-spawning mortality, both in the wild and in the MIT's White River hatchery sufficient to support our conclusion that the RPA would avoid an appreciable reduction in survival and recovery.

### 2.8.4 Effects of Complete Set of RPA Measures, Including Measures in the Proposed Action

The RPA adds new features to the Corps' proposed action that would provide safe and effective upstream and downstream passage for White River Chinook salmon and steelhead. Certain actions (e.g. discharging all inflowing water through the 23-foot tunnel during March through June) would be implemented immediately. Other actions (e.g. replacing the diversion dam with a modern fish barrier and replacing the fishway and trap) require additional design work and extensive construction and would not be fully completed until December 2020. Above, we described the effects of each of the RPA actions, focusing on each one individually. In this section we describe how these RPA actions, when combined with the proposed action would affect the White River populations of PS Chinook salmon and PS steelhead, and SR killer whales over the short term (from the date of issuance until December 2020) and the long term. There is a temporal component to the RPA measures, and we describe the effects in that context.

#### Effects in the Short-term

For this discussion, effects in the short term means effects anticipated to occur under the proposed action as modified by the RPA through the initiation of construction on the new fish barrier structure and trap and haul system in October 2016. Most of the effects of the action described in Section 2.4.2 would continue in the short term. Specifically, effects associated with: flood damage reduction operations (Section 2.4.2.2); large wood management (Sections 2.4.2.3 and 2.4.2.7); White River diversion repairs (Section 2.4.2.5); tunnel repairs (Section 2.4.2.6);



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and, repairs and routine maintenance of facilities other than dams (Section 2.4.2.9), would continue.

Flood damage reduction operations would have both beneficial and adverse effects. By reducing peak flows downstream from MMD to less than 12,000 cfs, the action would reduce the frequency and magnitude of redd scour, benefiting both PS Chinook salmon and PS steelhead eggs and pre-emergent fry. By occasionally releasing accumulated sediment following storage for flood damage reduction, the action would occasionally smother existing PS Chinook salmon and PS steelhead redds in the river reach downstream from MMD. About 30% of both PS Chinook and PS steelhead spawn in the White River downstream from the diversion dam and trap. We anticipate no more than 17 sediment releases associated with flood risk management operations and the implementation of RPA Action Item 1 each year. In aggregate, these sediment releases are expected to slightly reduce the productivity of both PS Chinook salmon and PS steelhead that spawn downstream from MMD. Because high peak flows are known to be inversely correlated to juvenile production and the effects of sediment slug releases are likely to be small, we consider the overall effect of flood damage reduction operations at MMD to be beneficial to both PS Chinook salmon and PS steelhead.

The Corps' proposed management of large wood includes stockpiling on site within the reservoir footprint, making it available for stream habitat improvement work, and ultimate disposal. This management scheme minimizes the adverse effects of the interruption of large wood transport caused by MMD by making collected wood available for aquatic habitat improvement projects that would benefit both PS Chinook salmon and steelhead in the White River basin.

Flow reductions to facilitate repair of the White River diversion dam would continue to occur as needed. Such operations have the potential to entrap and strand both adult and juvenile PS Chinook salmon and steelhead. The Corps would minimize the adverse effects of this action by coordinating flow reductions with NMFS, WDFW, and others and by conducting fish rescue operations as needed. Because such repairs would be scheduled to avoid periods when large numbers of adult fish are in the river, we anticipate that no more than 20 adult Chinook salmon and steelhead combined to be killed by flow reductions associated with repair and construction work each year during the short term. This adverse effect would continue throughout the short term.

MMD discharge tunnel repairs would continue to occur as necessary. We anticipate small to negligible juvenile fish passage delay and construction-related effects for continued tunnel maintenance and repair work.

Repairs and maintenance of facilities other than MMD, the White River diversion dam and the trap and haul system would have little if any effect on the species considered in this Opinion because they would not affect project operations or fish protection facilities, and would mostly occur well away from the river.

The Puget Sound Chinook salmon ESU is at a moderate risk of extinction (Ford 2011) and the White River population's viability is low. The Puget Sound steelhead DPS is at a high risk of extinction (Ford 2011) and the White River population's viability is low. Factors contributing to the low viability of these populations include poor passage survival. By passing most downstream migrating juveniles from habitats upstream of MMD through the dam's 23-foot discharge tunnel (that has been shown to provide safe passage), NMFS expects up to a five-fold increase in juvenile passage survival. We arrived at the size of the increase by comparing the current passage survival of 18% with the performance criteria of 95% that will begin in 2015. While there is not a one to one relationship between the amount that juvenile survival is increased and returning adults due to other factors, based on the large size of the increase in numbers of juveniles, NMFS expects a substantial increase in adult returns in 2 years for PS steelhead, and in 3 years for PS Chinook salmon. Because salmon and steelhead populations vary widely due to environmental conditions not associated with the MMD project, it is not possible to provide a specific estimate of the amount of anticipated increases in the abundances and productivities of these two populations.

We anticipate that up to 1,000 juvenile PS Chinook salmon and/or PS steelhead would be used as test subjects to conduct juvenile dam passage survival studies. Many, perhaps all of these test fish would be killed by the test. Because we anticipate that such tests would only be conducted a few times during the first ten years of the action and would primarily use hatchery fish, the overall effect of these juvenile passage survival studies on the abundance of returning spawners would be small to negligible and the information provided would be useful to identify changes in project operations that would improve survival over the long term.

We also anticipate that this action would also improve the survival of outmigrating PS steelhead kelts because they outmigrate during the period that RPA Action Item 1 requires all discharge to be passed via the 23-foot tunnel except as may be necessary to prevent excessive sediment accumulation. Because most kelts would pass through the 23-foot tunnel, which has been shown to provide safe passage, we anticipate that no more than 5% of the outmigrating steelhead kelts that pass through MMD would be killed. We conclude that there would be a substantial increase in kelt passage survival and a resulting increase in productivity of the population.

By reducing hazards posed by the existing White River diversion dam apron, the rate of injury and mortality to returning adults that currently occurs at the dam would be substantially lowered. This action would increase the numbers of adult salmon and steelhead that would survive to spawn in habitats upstream of MMD, thereby increasing both abundance and productivity of the populations. This action would also benefit juveniles by reducing injury to them as they pass the diversion dam. Juvenile exposure to the hazards posed by the dilapidated dam apron would be minimized by rapidly replacing the apron with a new, smooth surface. A smooth dam apron would minimize injuries to juveniles. Following replacement of the dam apron, we anticipate that less than 1% of the juveniles passing over the diversion dam would be severely injured or killed. PS steelhead and PS Chinook salmon would benefit from these actions that increase abundance and productivity, as would SRKW due to increased prey. We anticipate short-term minor adverse effects during construction of the new dam apron, including: possible entrapment and stranding (particularly of juveniles) during flow reductions needed to facilitate construction, and minor sediment releases. These effects would be minimized by coordination between the Corps, NMFS, WDFW, MIT, and PTI and adherence to best management practices during all phases of construction work.



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As described above in the likely effects of RPA Action Item 1, the periodic opening of the 9-foot tunnel necessary to prevent clogging is likely to slightly increase the frequency of the release of sediment slugs that could cause impacts to incubating steelhead eggs and pre-emergent fry in redds established downstream from the diversion dam. We expect this effect to be small due to the limited number of sediment release events (no more than 17 per year), and to be greatly exceeded by the benefits of RPA Action Item 1.

These short-term measures would avoid jeopardy by increasing the viability of the populations of PS Chinook salmon and PS steelhead, thereby increasing their likelihood of survival and potential for recovery. By improving the safe passage component of these fishes' designated and proposed critical habitats, these short-term measures also avoid adversely modifying critical habitat.

By increasing the population of White River PS Chinook salmon a small amount in the short term, these measures would provide a benefit to SR killer whale habitat by increasing the amount of their predominant prey. The importance of White River Chinook salmon to the whale's diet is unknown, but it is known that Chinook salmon is their predominant prey (seasonally up to 90% of their diet) and an important component of their designated critical habitat. Improving SR killer whale habitat by increasing the amount of their prey would increase the likelihood of SR killer whale survival and recovery to a point where there would be no appreciable reduction in survival and recovery because the impact on Chinook prey base will be so small with the RPA, and there would be no adverse modification of their critical habitat.

**Effects in the Long-term**

For this discussion, effects in the long term means effects anticipated to occur under the proposed action as modified by the RPA from the initiation of construction on the new fish barrier structure and trap and haul system in October 2016 through completion of the new fish barrier and trap and haul system in December 2020 and continued operation thereafter. Those effects of the proposed action described in Section 2.4.2 that would occur over the long term include: effects associated with: flood damage reduction operations (Section 2.4.2.2); large wood management (Sections 2.4.2.3 and 2.4.2.7); White River diversion repairs (temporarily) (Section 2.4.2.5); tunnel repairs (Section 2.4.2.6); and, repairs and routine maintenance of facilities other than dams (Section 2.4.2.9). The anticipated effects of these portions of the proposed action are described above for the short term. Changes in the effects described above for the short term would also continue to occur (operation of the 23-foot tunnel to discharge all incoming water, and replacement of the White River diversion dam approach apron). The largest change over the long term would be the replacement of the White River diversion dam with a modern fish barrier and replacement of the trap and haul system with one capable of safely moving up to 60,000 fish daily.

We analyzed the effects of improving downstream passage first, because temporally this is the first major beneficial effect of the RPA. However, in order to minimize the effect of the dam sufficiently to support viable populations of PS Chinook salmon and PS steelhead, passage needs to be safe and effective in both directions and serves two very important purposes. First, it increases survival by removing sources of very substantial mortality, thereby increasing overall



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population numbers. Second, it greatly increases the number of fish able to use extensive high quality spawning and rearing habitat available upstream of MMD, thereby increasing productivity and facilitating future population growth. Expanding the number of fish able to use the upstream spawning and rearing habitat increases the spatial diversity of the populations upstream of the project. By increasing the survival of migrating juveniles and adults, and supporting the increased use of upstream spawning and rearing habitat, this RPA would increase the abundance and productivity of the White River populations of PS Chinook salmon and PS steelhead. Increasing the abundance and productivity of the White River populations of PS Chinook salmon and PS steelhead would increase the abundance, productivity, and spatial diversity of the ESU and DPS, respectively, thereby ensuring survival, while also improving the long-term likelihood for species recovery. Increasing the abundance of the White River population of PS Chinook salmon benefits SR killer whale habitat by increasing prey, and would improve the likelihood of survival and recovery of SR killer whales.

Some adult fish transported to habitats upstream of MMD may volitionally pass downstream through MMD (termed fallback). Due to the distance between the release site and the dam, the amount of fallback is expected to be very small, probably less than 5% of the fish hauled upstream of the dam. PS Chinook salmon begin to enter the White River in April and passage at the trap extends until early October. Steelhead begin to enter the river in November and spawn during March through June. Thus, much of potential for fallback mortality occurs outside of the period when the distribution of discharge (percent of flow through each discharge tunnel) would be useful metric to estimate the amount of take. We anticipate that the level of fallback would be quite low and the effects to be insignificant.

We also analyzed the effects of improving passage on SR killer whale critical habitat, particularly the migration corridor PCE. The RPA measures greatly improve this PCE by opening up passage to the point where the numbers of fish able to pass both up and downstream are about the same as if no dam was present. Therefore, there will be no adverse modification of critical habitat for PS Chinook salmon and proposed critical habitat for PS steelhead. The resulting increase in prey base PCE for SR killer whales in Puget Sound is sufficient to avoid adversely modifying their critical habitat.

Minor additional adverse effects that would occur over the long term include the effects of construction activities, and monitoring and evaluation work that would employ ESA-listed fish as test subjects. The potential adverse effects of construction work would be minimized by coordination with NMFS and WDFW to schedule inwater work, conducting fish rescue operations as needed, and by complying with the best management practices (Appendix B). The anticipated effect of flow reductions to facilitate construction would be no more than 20 adult PS Chinook and PS steelhead combined killed each year during construction

Performance evaluation work would involve the capture, tagging, downstream transport and release of adult PS Chinook salmon and PS steelhead. This would injure, or kill prior to spawning, some adults that would be used as test subjects. We anticipate that up to 200 adult PS Chinook salmon and 100 adult PS steelhead would be handled and tagged, up to 10 adult PS Chinook salmon and 5 adult PS steelhead would be killed during handling and tagging, and up to 40 adult PS Chinook salmon and 20 adult PS steelhead would be killed by the each performance



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test. We anticipate that at least two and up to five such tests would be conducted to demonstrate performance and that such tests would be conducted once every five years thereafter to ensure continued performance, unless NMFS and the Corps determine it is not necessary.

By December 31, 2020, with completion of the upstream passage facility, as required in RPA Action Item 3, passage in both directions past the project will be safe and effective for Chinook salmon and steelhead juveniles and adults. At that time, MMD will no longer be an impediment to migrating fish, allowing them to safely migrate up and downstream. Implementing this measure would facilitate not only substantial improvement in abundance and productivity of White River PS Chinook salmon and PS steelhead, and increase spatial structure, it would remove a substantial impediment to their recovery. The new fish barrier structure and trap and haul system would be designed to move as many as 60,000 fish (mostly pink salmon, but including all listed Chinook salmon and steelhead) per day, thereby providing safe passage conditions sufficient to support a viable salmon population that is an essential component of actions needed to support recovery. NMFS has not yet set a population abundance recovery goal for PS Chinook salmon, but the TRT has identified a minimum viability abundance of 14,200 fish (in Ford 2011), suggesting the recovery goal would be similar. Thus, an adult fish passage system capable of transporting up to 60,000 fish per day, including up to 800 Chinook salmon would avoid the proposed action's appreciable reduction in the likelihood for the survival and recovery of both PS Chinook salmon and PS steelhead.

Because the RPA is based on survival standards, operations may have to be modified in order to meet those standards as the anticipated effects of climate change occur. As base flows change from previously-observed flows (higher and more flooding in winter and lower in summer) the operations may need to adjust in order to meet the survival standards. Therefore, the RPA will work under anticipated climate change (or reinitiation will be triggered because the survival standards aren't met).

Implementing this RPA would avoid adverse modification of critical habitat for PS Chinook salmon and proposed critical habitat of PS steelhead by returning the safe passage PCE of critical habitat to a properly functioning status. Safe and effective passage would also provide proper function to existing high quality upstream spawning and rearing habitats by providing greater fish access to them.

Implementing this RPA would avoid adverse modification of critical habitat for SR killer whale. This RPA would increase the population numbers of PS Chinook salmon, thereby improving the prey PCE of SR killer whale designated critical habitat. Consequently, project operations under the RPA are not likely to result in local depletions of killer whale prey that could appreciably reduce the whales' likelihood of survival and recovery.

In summary, the long term effects of the RPA would remove sources of injury mortality associated with the MMD project, and allow White River Chinook salmon and steelhead to pass upstream and downstream safely and effectively. This would allow population numbers to increase by increasing the number of spawning adults, eggs, juveniles, increasing abundance and productivity. Because more fish would be able to use extensive upstream habitat, their spatial diversity would increase, buffering effects of a disaster in one part of their habitat. By increasing



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numbers of PS Chinook salmon, the RPA would also benefit SR killer whales in the long term by benefitting their habitat by increasing their prey base.

### 2.8.5 Conclusions

After reviewing the current status of the listed PS chinook salmon and PS steelhead (moderate to high risk of extinction for PS Chinook and PS steelhead, respectively), the environmental baseline within the action area (degraded), the anticipated effects of the RPA (beneficial effects on spawning and incubating fish downstream from the diversion dam, with very large beneficial effects by providing safe and effective passage for juveniles and adults to and from high quality habitat upstream of MMD), and cumulative effects (mixed positive and negative ), it is NMFS biological opinion that the RPA will avoid jeopardy and destruction or adverse modification of PS Chinook critical habitat and PS steelhead proposed critical habitat.

After reviewing the current status of SR killer whales (endangered with declining abundance), the environmental baseline within the action area (degraded), the anticipated effects of the RPA (increased production of essential prey species, PS Chinook salmon), and cumulative effects (mixed positive and negative), it is NMFS' biological opinion that that the RPA will avoid jeopardy and adverse modification of critical habitat.

### 2.8.6 The Corps' Implementation Decision

Because this biological opinion has found jeopardy to PS Chinook salmon, PS steelhead, and SR killer whales and destruction or adverse modification of PS Chinook salmon and SR killer whale critical habitat, and PS steelhead proposed critical habitat, and offers a reasonable and prudent alternative to avoid jeopardy and adverse modification of critical habitat, the U.S. Army Corps of Engineers (Corps) is required to notify NMFS of its final decision on implementing the RPA (50 CFR 402.15(b)) within 60 days of the issuance date of this biological opinion. NMFS is aware that the Corps would need to seek and receive Congressional funding. Failure to obtain authorization and funding to implement this RPA in a timely manner would be cause for reinitiation of consultation.

## 2.9 Incidental Take Statement

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

This incidental take statement addresses the incidental take anticipated as a result of the implementing the RPA). Put another way, this ITS assumes the Corps fully adopts and successfully completes the RPA, including the timelines in the RPA (Section 2.8 above).

### 2.9.1 Amount or Extent of Take

In this Opinion, NMFS determined that the RPA - which modifies the proposed action - would cause incidental take as follows.

#### *2.9.1.1 Downstream passage through discharge tunnels*

*Juveniles*: We anticipate that operation of the 9 foot downstream discharge tunnel under the RPA will result in death of some out-migrating juvenile fish. As explained in the opinion, studies show that this tunnel results in high levels of juvenile mortality (i.e. ~82%), although the precise causes of mortality are uncertain. The RPA severely limits use of this tunnel during the peak migration months, from March through June, but it would still be used under specified circumstances during these months. Quantifying the numbers of juvenile fish killed by passage through the MMD discharge tunnels is not practicable because many thousands of juveniles pass through MMD, there is no smolt monitoring system at the project, and installing such a system would be technologically challenging and would cause additional stress to the fish. The RPA sets a performance standard of 95% smolt passage survival through the dam, and for the same reasons it is also not practicable to directly measure compliance with this criterion. In this case, the distribution of project discharge between the two tunnels, as a percentage of total discharge, times the known rate of juvenile mortality for each tunnel provides the best available surrogate for the amount of take. This surrogate is readily quantifiable because there are flow control mechanisms for each of the two outlet tunnels. In addition, the surrogate is rationally related to the take caused by the tunnel because we know the level of take associated with juvenile passage through each tunnel. Specifically, there is no mortality associated with passage through the 23-foot tunnel, but an 82% mortality rate associated with passage through the 9-foot tunnel. Thus, for example, if 10 percent of flow were to pass through the 9-foot tunnel, we would assume an 8.2 % mortality rate (82% x 10); but, if 6.1% of flow were to pass through the 9’ tunnel, we would assume a mortality rate of ~5% (and a survival rate of ~95%). NMFS’s analysis of the RPA assumes the 95% survival rate will be achieved. Accordingly, the best available limit for juvenile mortality associated with downstream passage through MMD discharge channels is a maximum of 6.1% of discharge flow through the 9-foot tunnel from March 1 through June 30 each year. A fraction (<5%) of the annual juvenile outmigration would occur outside of the March through June window and would likely pass through the 9-foot tunnel and suffer high rates of mortality. For the remainder of the run, traveling outside the March - June time frame, this means that take for these juveniles would be, at most, 82% (take from the 9 foot tunnel) of the less than 5% of the total number of juveniles, would be taken. This is a reasonable surrogate for take across the year – including July-February – because it accounts for flows and the fish traveling downstream throughout the year. It will function as an effective reinitiation trigger because it requires an annual check-in on a long term action.

*Adults*: Some incidental take of adult PS Chinook salmon and steelhead is also expected as a result of downstream passage through MMD discharge tunnels. Some adult fish transported to habitats upstream of MMD may volitionally pass downstream through MMD (termed fallback).



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Steelhead that survive spawning (termed kelts) would also attempt to pass downstream through MMD to reach the sea. While it may be theoretically possible to count the associated fish carcasses they would be indistinguishable from carcasses related to the take pathway described in 2.9.1.2. Thus, the best available surrogate available relates to flow rates through the tunnels. This surrogate is rationally related to the take because both fallbacks and kelts are expected to encounter hazards similar to those that reduce juvenile survival when passing MMD, resulting in rates of injury and/or death related to which of the two discharge tunnels they pass through and those levels of take were assumed in the Opinion. Thus, the take indicator for adult downstream passage is the same as for juveniles.

#### *2.9.1.2 Diversion dam and operation of trap and haul facility*

*Adults*: The rough surfaces and other hazards associated with the approach apron, as well as the migration delay caused by the dam, are expected to cause injury and mortality of adult PS Chinook salmon and steelhead until those structures are upgraded/replaced under the terms of the RPA. The approach apron has hazards such as exposed rebar, loose boards, and voids, which descales, abrades skin, and causes other injuries including death. The inadequate capacity to move fish at the trap also causes migration delay, which increases the level of take because it increases the exposure of PS Chinook salmon and steelhead to hazards at the diversion dam. Studies have also shown that increased delay results in a lesser chance of delayed fish reaching the spawning grounds, indicating pre-spawning mortality (Caudill et al 2007). This incidental take is expected to be significantly reduced within the next year due to RPA requirements to replace the dam apron by the end of August 2015. Once the existing diversion dam is replaced and a new trap and haul system becomes operational in 2020, we anticipate a low level of death and serious injury of migrating adults.

The level of anticipated take varies through time as elements of the RPA are completed. Until August 2015, take (death and severe injury) would be 20% of all returning adult PS Chinook salmon and steelhead. After August 2015, the new dam approach apron would be completed and the incidence of severe injury and death would be reduced to 10% of the adult PS Chinook salmon and steelhead. Following full replacement of the diversion dam and trap and haul system, the amount of anticipated take would be 2% of the fish that enter the trap. This is the amount of take anticipated in our analysis of the RPA based on the Corps meeting the 98% passage survival standard. Anticipating take as a percentage of the total returns of adult fish makes more sense than an absolute number, because the size of the PS Chinook salmon and PS steelhead populations will vary through time and while this variation will be reflected in the actual numbers, the percentage of the returning adults that is killed or injured through operation of the diversion dam and trap is more relevant to effects on the species. For example, take of 100 fish in a year of low numbers of returns has very different effects than the same amount of take in a year of very high returns. This amount of take will be measured by counting the number of dead fish and fish with more than minor injuries (likely to die before spawning) that enter the trap and observations of carcasses downstream of the diversion dam/fish barrier. The amount of take would be exceeded if more than: 20% of the returning adult PS Chinook or 20% of PS steelhead are severely injured or killed in 2015; 10% of PS Chinook salmon or 10% of PS steelhead are severely injured or killed in any year from August 2015 through December 2020 (use of new apron on front of diversion dam); and, 2% of returning adult PS Chinook salmon and PS steelhead are severely injured or killed after December 2020 (operation of new upstream passage facilities including new barrier structure).

*Juveniles*: The rough surfaces and other hazards associated with the approach apron are also expected to cause low levels of injury and mortality of juvenile PS Chinook salmon and PS steelhead until those structures are upgraded under the terms of the RPA. We anticipate low levels of juvenile take due to passage over the diversion dam because unlike adults that may be exposed to the hazards at the dam apron for hours to days, juvenile downstream passage would be unimpeded and exposure to the hazards of the dam apron would last for seconds to minutes. Juveniles are in contact with the dam only due to their passing over the dam with the river water as it flows over the dam. As with adults, the hazards to juvenile Chinook salmon and steelhead posed by the dilapidated dam apron are likely to abrade skin, descale, and cause other injuries, including death. Quantifying the actual numbers of juvenile fish injured or killed as a result of the diversion dam apron is not practicable because there is no available method or technology to detect passing juveniles and identify those that are injured or killed. We are therefore using the duration that these hazards would persist under the RPA as a surrogate take indicator. The take surrogate would be exceeded if the diversion dam approach apron is not replaced by August 2015 or if the diversion dam is not replaced by December 31, 2020. This take surrogates is proportional to the amount of take because the greater the length of time that passes before the apron is replaced, and the diversion dam is replaced, the larger the number of passing juveniles that would be injured or killed. This surrogate would serve as an effective reinitiation trigger because failure to meet this limit would be obvious, would occur within a relatively short time period as compared with the expected duration of the action, and could be effectively remedied.

***Sediment releases.*** As described in the Opinion, sediment releases from MMD are expected to result in low levels of death or injury to PS steelhead and Chinook salmon eggs and intergravel fry. Studies have shown that eggs and intergravel fry can be killed by influxes of fine sediment into established redds. Sediment on the redds causes suffocation by filling in the spaces in the gravel and cutting off the oxygen supply. Sediment releases may also cause injury or death to fish in the MIT White River hatchery by clogging the water intake. Reducing the flow into the hatchery could result in inadequate water supply, suffocation, and death of fish in the hatchery, particularly incubating eggs. Quantifying the numbers of eggs or fry killed or injured as a result of sediment releases is not practicable because the redds are difficult to identify during highly turbid flows and because sampling redds to determine egg survival would kill a large number of eggs. It is also not practicable to quantify the number of fish injured or killed in the hatchery because ESA-listed fish production at the hatchery varies year to year based on availability of broodstock and other management objectives. Additionally, there is no way to predict how many fish would be killed if a full or partial clog was caused by a sediment release.

We therefore need to use a surrogate to measure take caused by sediment releases. Sediment releases occur every time the 9 foot tunnel is opened following flood storage events and as may be required by exclusive use of the 23-foot tunnel from March through June (RPA Action Item 1). Therefore, using the number of sediment releases at MMD from November through June (this is the time frame when flood and sediment events occur) is an appropriate surrogate for take due to sediment releases. For this ITS, a sediment event is defined as any opening of the 9-foot tunnel following a flood event or as deemed necessary by the Corps to clear the MMD discharge tunnel intake of sediment (see RPA Action Item 1). This surrogate is rationally related to the sediment-related incidental take because the greater the number of sediment releases between November and June, the higher number of redds affected and the larger of number of eggs and fry that would be killed. This surrogate also correlates to the take of hatchery fish because the more sediment releases that occur in one November through June period, the greater the chance that one of these events would clog the hatchery water intake and cause related take. Under the RPA, the operation of MMD is expected to result in a maximum of 17 such events between November and June each year, and thus the take surrogate will be exceeded if more than 17 events occur.

#### *2.9.1.3 Construction and Repair Activities*

Construction and repair activities are likely to injure or kill small numbers of juvenile and adult Chinook salmon and steelhead. Specifically, entrapment and stranding of juveniles and/or adults is expected to occur during flow reductions associated with construction and repairs. In addition, sediment releases during construction could cause suffocation of some juveniles and/or adults during brief but intense sediment releases associated with construction and repairs.

When the White River diversion dam requires repair the Corps would reduce water discharge at MMD to facilitate dam repair. Such flow reductions have caused entrapment and stranding in the past. While the Corps would coordinate flow reductions to facilitate repairs with WDFW and NMFS to determine the best in-water work windows that minimize take and conducts fish rescue operations as needed, some fish are expected to die during each flow repair cycle. Because the Corps would be searching for stranded fish during the time the reduce water levels to complete construction or repairs, it would be possible to enumerate the amount of take. Due to inwater work timing and construction best management practices, we expect a relatively small number of fish to be injured or killed by construction and repair activities. As explained in the Opinion, we expect that no more than 20 adult PS Chinook salmon and PS steelhead combined would be stranded annually due to flow reductions made to facilitate construction and repair activities. Thus, this is the amount of take. These adults would be easily observable in the vicinity of the construction site.

It is not practicable to quantify take associated with sediment releases during construction because by their nature, sediment release events would obscure any mortalities that occur. The best available surrogate for take due to construction-related sediment releases is the extent of construction-caused suspended sediment plumes. Suspended sediment plumes can kill fish, particularly fry and juvenile fish by suffocating them. This effect dissipates downstream as sediment routing and deposition reduce the concentration of suspended sediments, reducing the effect. The extent of the visible sediment plume also serves as a surrogate for the total amount of disturbance to the aquatic environment caused by inwater construction and repair activities. This is because inwater construction actions that result in significant disturbance to the aquatic environment typically cause large sediment plume while better managed construction actions with appropriate conservation measures typically result in smaller sediment plumes and less total disturbance. For this reason, the extent of visible sediment plumes best integrates the likely take pathway associated with this action, is proportional to the anticipated amount of take, and is the most practical and feasible indicator to measure incidental take. The extent of take will be exceeded if the turbidity in nephelometric turbidity units (NTUs) 1,000 feet below the construction site exceeds background levels (to be measured upstream of the construction site) by more than 50%.

#### *2.9.1.4 Monitoring and evaluation.*

Incidental take is expected as a result of monitoring and evaluation requirements of the RPA. Specifically, the RPA requires scientific studies designed to evaluate the performance of the MMD fish passage system, and tracking studies that will involve surgically implanting tracking devices into adult PS steelhead and Chinook. In addition these test fish would be hauled downstream to facilitate tracking back to the trap and to their point of release to measure performance of the adult passage system. In addition to the handling of juvenile fish associated with evaluations of the fish passage system, NMFS expects that some fish will be injured or die as a result of the surgical process and some will be injured or killed by the test itself .

As indicated in the Opinion, up to 200 adult PS Chinook salmon and 100 adult PS steelhead test fish would be required to obtain sufficient scientific rigor to demonstrate compliance with the performance criteria. The amount of lethal take anticipated as a result of tagging and handling mortality is 10 individual adult Chinook salmon and 5 individual steelhead for each study (annually until the RPA criteria are met, and then every five years, unless NMFS and the Corps determine it is not necessary). The amount of take anticipated as a result of the test itself is 40 adult PS Chinook salmon and 20 PS steelhead individuals. Take in excess of these amounts would exceed the level of take exempted by this ITS.

The amount of incidental take anticipated as a result of monitoring (via handling) is up to 1,000 juvenile PS Chinook salmon and PS steelhead annually (combined) for scientific studies designed to evaluate the performance of the MMD fish passage system.

#### *2.9.1.5 SR killer whales*

NMFS is not including an incidental take exemption for SR killer whales at this time because the incidental take of marine mammals has not been authorized under section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments. Following issuance of such regulations or authorizations for marine mammals, NMFS may amend this Opinion to include an incidental take statement for marine mammals.

### 2.9.2 Effect of the Take

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

### 2.9.3 Reasonable and Prudent Measures (RPM)

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

#### *2.9.3.1 Strict adherence to all aspects of the RPA, including all timelines in the RPA (RPM 1)*

To ensure timely implementation of all RPA measures, the Corps must comply completely with the RPA, including meeting all the timelines provided in the RPA for completion of the measures, including the steps toward completion that the Corps must demonstrate annually, as provided in the RPA.

#### *2.9.3.2 Monitoring and Adaptive Management (RPM2)*

The Corps must monitor passage survival at MMD and the trap and haul system of adult and juvenile PS Chinook and PS steelhead annually until the new trap and haul system is completed (2020) and for the first three years after the new facility has been operating (including 2 years of pink salmon runs) to demonstrate compliance with this ITS. If the adult trap and haul facility is not working as expected, and not meeting the performance criteria; then the Corps must continue monitoring annually until the performance criteria have been met during 2 pink salmon runs. Once the facility is meeting performance standards, the Corps must then monitor once every five years, unless NMFS and the Corps determine it is not necessary.

The Corps must also monitor fallback mortality immediately downstream from MMD.

The Corps will monitor the project to ensure that it is meeting the performance and design criteria.

#### *2.9.3.3 Best Management Practices (RPM 3)*

Implementing the proposed action and RPA will require in-water work. To minimize take caused by in-water construction work, the Corps must coordinate with NMFS and the Washington Department of Fish and Wildlife to identify in-river work windows, and employ the best management practices as provided in the Portland District Corps' Standard Local Operating Procedures for Endangered Species (SLOPES, NMFS 2012b).

### 2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the Corps must comply with them in order to implement the reasonable and prudent measures (50 CFR 402.14). The Corps 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 incidental take statement (50 CFR 402.14). If the following terms and conditions are not complied with, the protective coverage of section 7(o)(2) will likely lapse.

#### *2.9.4.1 Term and Condition 1-annual report on Corps' compliance with RPA timelines implementing RPM 1*

Beginning on January 31, 2015 and every January 31 thereafter, until all RPA action items have been completed, the Corps must provide NMFS with an annual progress report, identifying the status of each major design step (e.g. 30%, 60%, 90% and 100% designs), permits, funding, and construction schedule, any difficulties identified (e.g. delay in meeting a milestone), and specifying any remedial actions being taken to get back on schedule. Corps must include the status of all milestones needed to ensure project completion by December 2020.

### *2.9.4.2 Term and Condition 2–monitoring incidental take, and adaptive management – implementing RPM2*

To ensure that the Corps meets both the upstream and downstream performance and design criteria, the Corps will design, in collaboration with NMFS, and with NMFS' concurrence, a program to monitor take caused by the project. The Corps will conduct the monitoring, and if the project cannot meet the RPA performance standards and design criteria, then the Corps will collaborate with NMFS to determine the appropriate means to modify its operations or facilities to meet the criteria. The Corps will then make those modifications.

### *2.9.4.3 Term and Condition 3–monitoring incidental take, and adaptive management – implementing RPM2*

To monitor take at the project, the Corps must do the following:

- To monitor the lethal take of outmigrating PS Chinook salmon and PS steelhead, the Corps must determine the fraction of total project discharge that is released via the 9- foot tunnel from March 1 through June 30 and multiply that value (percent passage through 9-foot tunnel) by the estimated mortality through that tunnel. The estimated mortality through the 9-foot tunnel will be 82% until additional study demonstrates a different rate of survival and NMFS approves the change.
- To monitor the take of returning adult PS Chinook salmon and PS steelhead that reach the diversion dam, the Corps must annually report the number of listed fish (by species) observed dead in the river directly downstream from the trap (within 300 feet of the apron), collected and transported at the trap, and the fraction of collected fish that are dead or display more than minor injuries. All ESA-listed fish that display more than a minor injury will be included in the take estimate for reporting purposes. The total number of listed fish observed dead, or displaying more than minor injuries divided by the total number of fish (by species) transported upstream of MMD is the fraction of fish reported as incidental take.
- Following completion of the new barrier structure and trap and haul system, the Corps must perform an adult Chinook salmon passage survival study using PIT- or radio-tagged fish (or similar) during a high pink salmon run year (either 2019, 2021 or 2023). This study must be conducted in accordance with a study plan that has been reviewed and approved by NMFS. In the report from this study, the Corps must estimate the attraction rate of Chinook salmon approaching the fishway, delay in ascending the fishway, the duration of being held in the fishway through release upstream of MMD, and survival from approach to the barrier structure through release upstream of MMD.
- To monitor take associated with flow reductions required for diversion dam repair or construction of the new fish barrier and trap and haul system, the Corps must conduct fish rescue operations during each flow reduction event and report all dead PS Chinook salmon and PS steelhead observed, by life stage (adult, juvenile) during each survey.

- To monitor take caused by sediment releases during construction the Corps must collect turbidity measurements upstream of active construction sites and 1000 feet downstream from the site at least daily during all construction activities. During construction events likely to result in a sediment release event (e.g. cofferdam removal), turbidity must be measured during the event both upstream and 1000 feet downstream from the construction site.
- To monitor take associated with research, monitoring, and evaluation activities the Corps must identify the source, species, and life stage of all test fish used in each study, the number killed due to tagging and handling, and the estimated number of test fish killed by each test.
- An annual take report must be provided to NMFS by January 31 each year specifying the Corps' estimated incidental take for the prior calendar year. For brevity, this report may be included in the annual progress report until construction work is completed.

#### *2.9.4.3 Term and Condition 4–use of best management practices-implementing RPM 3*

The specific protective measures the Corps must employ during in-water/over-water work are provided in Appendix B.

### 2.10 Reinitiation of Consultation

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

The consultation requirement of Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect EFH. The MSA (Section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that may be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific coast salmon (PFMC 1999) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Department of Commerce.

### 3.1 Essential Fish Habitat Affected by the Project

The project action area includes EFH for Chinook salmon, coho salmon, and Puget Sound pink salmon (PFMC 1999). The proposed action and action area for this consultation are described in Sections 1.3 and 1.4 of this document. The action area includes areas designated as EFH for adult, fry, juvenile, and smolt life history stages of Chinook salmon *(Oncorhynchus tshawytscha)*, coho salmon *(Oncorhynchus kisutch)*, and pink salmon *(Oncorhynchus gorbushca)*. No Habitat Areas of Particular Concern have been identified in the action area.

### 3.2 Adverse Effects to Essential Fish Habitat

Based on information provided in the Biological Assessment (BA) (Corps 2013a) and the analysis of effects presented in the biological opinion, NMFS concludes that the proposed action would adversely affect EFH designated for Pacific Salmon by obstructing effective fish passage, and diminishing the value of spawning and rearing habitats. The project also provides beneficial effects on Chinook and pink salmon EFH by reducing peak flow-induced scour downstream of MMD, which improves the survival of incubating eggs and alevins.

### 3.3 Essential Fish Habitat Conservation Recommendations

NMFS expects that the RPA (Section 2.8 above) and the reasonable and prudent measures required in our ITS (Section 2.9 above), in addition to the measures in the proposed action, will conserve EFH. Consequently, NMFS adopts those measures as our EFH conservation recommendations.

NMFS expects that full implementation of these EFH conservation recommendations, combined with the mitigative measures included in the proposed action, would protect, by avoiding or minimizing the adverse effects described in Section 3.2 above, in the White River EFH used by PS Chinook and pink salmon.

### 3.4 Statutory Response Requirement

As required by Section 305(b)(4)(B) of the MSA, the Federal agency (in this case the Corps) must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation from NMFS. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH conservation recommendations, unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, mitigation, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS' Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over

the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(k)(l)].
In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

### 3.5 Supplemental Consultation

The 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)].

## 4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (the Data Quality Act) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

### 4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the U.S. Army Corps of Engineers (Corps). Other interested users could include Cascade Water Alliance, local Native American tribes, agencies of the State of Washington, King and Pierce Counties, conservation organizations, and citizens in affected areas. Individual copies of this opinion were provided to the Corps. This opinion will be posted on the NMFS West Coast Region web site (http://www.westcoast.fisheries.noaa.gov/). The format and naming adheres to conventional standards for style.

### 4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

## 4.3 Objectivity

Information Product Category: Natural Resource Plan.

**Standards:** This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

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

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

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



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## APPENDIX A

# Design Criteria for the New White River Fishway



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## Overarching Guidance

The fishway, including the new fish barrier structure, upstream fishway, trap, sorting, haul, transport and release facilities must all be designed consistent with (NMFS 2011b) guidelines (Anadromous Salmonid Passage Facility Design, National Marine Fisheries Service, 2011, Portland OR). The primary purpose for the new fishway is to provide safe, timely and effective fish passage over a wide range of conditions. The new fishway should also facilitate ESA-broodstock collection for hatchery propagation (e.g. Muckleshoot Indian Tribe's [MIT's] White River hatchery). [1] The new facilities must meet the passage performance criteria provided in the RPA:

- 95% safe and timely attraction of adults to facility;
- 98% survival of adults through the facility to their release upstream of MMD;
- Design criteria to safely handle up to 1.25 million salmon per year; and
- Transfer up to 60,000 fish per day.

## Design Team

The Corps must assemble an agency and Tribal design team including members from the Corps, NMFS, U.S. Fish and Wildlife Service, Washington Department of Fish and Wildlife, Muckleshoot Tribe, Puyallup Tribe, and Cascade Water Alliance (parties may chose not to join the team) to jointly develop the design of the upstream fish passage facilities. The team will work together collaboratively and coordinate on design decisions for the barrier dam, upstream fishway and trap and haul facilities.

There are at least two design concept options that the Corps needs to develop and the agency/Tribal design review team needs to consider and evaluate for meeting the RPA's performance criteria; entrances for fish collection on both sides of the White River, or one side of the river only, or some modified version of these options. Because time is of the essence, the team may need to evaluate and begin design of more than one option simultaneously to avoid potential delays. NMFS must concur with each design phase (preliminary design, 60%, 90%, 100%). The design concept evaluation and decision process must not delay completion of the preliminary design document.

## Preliminary Design and Completion Schedule

- Complete Final Decision Document (including preliminary design and schedule for 60, 90, 100% design completion and other project milestones [e.g. Gantt chart]) by June 2015 (for FY 17 budget consideration)
- Construction phase start - October 2016
- Complete construction and ensure the facility is operational - December 2020

[1] Design consideration should be given to either ensuring attraction to the existing hatchery fishway, or collection systems at the Corps' new fishway that can serve hatchery broodstock needs. Improvement to the MIT White River hatchery is not part of this design guidance.

The design team will develop a complete project schedule (e.g. Gantt chart) that covers the project from development of the preliminary design(s) through project completion, including anticipated dates for the completion of 60, 90, 100% designs and critical dates necessary to achieve the RPA goal of having an operational trap and haul system in place by December 2020.

The preliminary design will include a facilities layout (including some section drawings), with identification of size and flow rate for primary project features. Completion of the preliminary design commonly results in a preliminary design document that may be used for budgetary and planning purposes, and serves as a basis for soliciting design review comments by the involved agencies and Tribes, and must achieve NMFS' concurrence. The Corps will provide the agency/Tribal design review team adequate time to review and influence the design process (at least 15 days for each design step [preliminary design, 60, 90, and 100% designs]).

The preliminary design is commonly considered to be at the 30% completion stage of the design process, and must be completed by the design team and concurred with by NMFS by March 31, 2015. The additional design phases, commonly considered to be at the 60, 90 and 100% completion stage, must be concurred with by NMFS. No design step is complete until it achieves NMFS' concurrence. Construction of the new facilities must be completed and be operational by December 31, 2020. Construction methods (staging) must ensure that stream function and fish passage is continually maintained. All construction methods must comport with the SLOPES Best Management Practices (Appendix B).

**Design Flow Requirements**
The upstream fishway facilities, including the velocity barrier, the fish ladder and trap, hold, and haul components, must be operational and within the design criteria stated in this RPA between the minimum instream flow (Table 3, Section 2.3.2 in this Opinion) and the 5% exceedence flow, based on daily average flow levels from the composite upstream fish passage season for all species, or as agreed to in subsequent design development discussions with NMFS. The fishway design should have sufficient river freeboard to minimize overtopping by 50-year flood flows. Above a 50- year flow event, the fishway operations may include shutdown of the facility in order to allow the facility to quickly return to proper operation when the river drops to within the range of fish passage design flows. The fish passage facility should be of sufficient structural integrity to withstand flows up to 12,000 cfs, the maximum expected flow. Routine annual maintenance downtime will be no more than 14 days [or a duration agreed to in writing by NMFS], and will be scheduled to minimize impacts to listed fish species.

**Fishway Entrance Requirements**
Fishway entrances must be located at points where fish can easily locate the attraction flow and enter the fishway. When choosing an entrance location, high velocity and turbulent zones in a spillway tailrace should be avoided. If an entrance is located where the tailrace is wide, shallow, and turbulent, then excavation to create a deeper, less turbulent holding zone adjacent to entrances may be required.

Fishway entrances must be designed to convey the maximum fishway attraction flow (5%-10% of the maximum design flow [see above]), with sufficient operational flexibility to adjust the fishway entrance head (fishway entrance pool to tailwater water surface differential) between 0.5



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and 2.0 feet to account for tailwater elevations and river flows for the entire range of fishway design flows. The target fishway entrance head must be 1.0 to 1.5 feet, for all tailwater elevations and river flows within the fishway design flow range.

Other design criteria and guidelines are provided in Section 4.2 of the NMFS Fishway Design Manual (NMFS 2011b), and these must apply to the entrance design as well. Subsequent iterations of the design of these entrances are to be developed in consultation with interested agencies and tribes, with final design subject to approval by NMFS, as per the Design Schedule and RPA.

We do not currently (September 2014) have enough design information to know whether fishway entrances would be needed on both banks to meet the passage criteria, or just one. However, we need an action to evaluate for purposes of determining the take associated with the RPA. Therefore, we are providing a default conceptual design that includes entrances on both banks for purposes of our analysis. This design would provide for at least two fishway entrances, one on each side of river, near the downstream terminus of velocity barrier aerated flow at maximum fishway design river flow. At least one would be located on the left bank of the river (looking downstream) at the downstream terminus of velocity barrier aerated flow at minimum river flow.

**Fishway Attraction Flow Requirements**
The combined attraction flow amount from all fishway entrances should be between 5% and 10% of the river flow. For example, if 3,600 cfs river flow is verified as the 5% exceedence flow for the composite upstream fish passage season (i.e. all anadromous salmonid species), then a minimum of 180 cfs (0.05 X 3,600) should be used for the fishway entrance attraction flow. The fishway attraction flow is a combination of auxiliary water system (AWS) flow plus ladder flow, with specific flow for each component dependent on design decisions made regarding holding and transport, as described below. If the design team chooses a design with fishway entrances on one bank only, the attraction flows may need to be considerably higher and concurred with by NMFS. A single bank entrance could mean 370 cfs or more for attraction flows coming through the AWS.

**Screening Intake Requirements**
All water intakes from the river supplying the fish passage facility must be screened according to Section 11 of NMFS Anadromous Salmonid Passage Facility Design (NMFS 2011b).

**Fishway and Trap Holding Pool Capacity Requirements**
ESA listed fish must not be delayed or held for longer than 24 hours in the project tailrace and the fishway facilities. (The limited exception to this requirement is that when there are very few ESA-listed fish [e.g. less than 5] entering the trap over a weekend, the Corps is not required to move the fish over a weekend and may hold fish up to 60 hours as long as conditions in the trap are suitable to safely hold fish for up to 60 hours [e.g. suitable temperatures and no crowding]). In a single day, up to 10% of the annual run can pass the fishway and require trapping for transport above Mud Mountain Dam. The system must be designed to accommodate a maximum of 60,000 salmon (this includes an estimated 300 ESA-listed salmon) per day arriving at the fish barrier. To separate ESA-listed salmon (PS Chinook and PS steelhead) from unlisted fish species

(e.g. pink salmon), the facility will include a holding pool (or pools) for non-listed salmon. This holding pool(s) should provide a minimum volume of 0.25 cubic feet per pound of fish (per 6.5.1.2 of NMFS Fish Passage Design Manual, 2011), and a minimum depth of 6 feet. These pools must be fitted with appropriate crowders and fish lift systems to load fish into transport trucks for conveyance upstream of Mud Mountain Dam. It is also allowable to consider increasing upstream transport frequency and capacity and/or increasing the upstream fishway pool volume and flow capacity to reduce the required volume of off ladder holding pools. Subsequent iterations of the design of these pools and loading systems are to be developed in consultation with interested agencies and tribes, with final design subject to concurrence by NMFS.

**Fishway Drop between Pool Requirement**
A maximum of one-foot drop is allowable between fishway pools, according to section 4.5.3.2 of NMFS Anadromous Salmonid Passage Facility Design Manual (NMFS 2011b).

**Trapping, Sorting, Loading and Fish Transport Requirement**
The design must include sufficient fish sorting and holding facilities to accommodate hatchery broodstock collection for the MIT's White River salmon hatchery and to count and assess the condition of ESA-listed fish passing through the facility and hauled to release sites upstream of Mud Mountain Dam. Water to water transport must be used, with facilities designed according to Section 6 of NMFS Fish Passage Design Manual (NMFS 2011b).

**Transport Capacity Requirement**
For upstream transport of all adult salmon with no long term holding (i.e. greater than 24 hours), provide sufficient safe transport capacity to move up to 60,000 salmon per day. Sorting of ESA listed fish and adequate holding facilities for other fish must be included in the facility design. Increasing the holding pool capacity could reduce the number of transport trucks needed. Subsequent iterations of the design of the transport and holding systems are to be developed in consultation with interested agencies and tribes, with final design subject to concurrence by NMFS.

**Adult Fish Release Requirement**
After upstream transport, fish must be released in a safe location with good water quality. Fish should not be dropped more than six feet, and the receiving water must be at least three feet deep. Water quality (water temperature and dissolved oxygen) at the release site should be representative of the general water conditions in the river at the release site, and water tempering techniques must be used before ESA-listed fish are released. The release site must provide direct and simple egress for fish into the river for continued upstream migration.

**APPENDIX B**

# Best Management Practices for In-Water Work

**1. <u>Pollution and erosion control</u>.** Any action that will require earthwork and may increase soil erosion and cause runoff with visible sediment into surface water, or that will require the use of materials that are hazardous or toxic to aquatic life (such as motor fuel, oil, or drilling fluid), must have a pollution and erosion control plan that is developed and carried out by the applicant, and commensurate with the scale of the action.

a. The plan must include practices to minimize erosion and sedimentation associated with all aspects of the project (*e.g.*, staging areas, stockpiles, grading); to prevent construction debris from dropping or otherwise entering any stream or waterbody; and to prevent and control hazardous material spills.

b. During construction, erosion controls and streams must be monitored and maintained daily during the rainy season and weekly during the dry season as necessary to ensure controls are properly functioning.

c. If monitoring shows that the erosion controls are ineffective at preventing visible sediment discharge, the project must stop to evaluate erosion control measures. Repairs, replacements or the installation of additional erosion control measures must be completed before the project resumes.

d. Proper maintenance includes removal of sediment and debris from erosion controls like silt fences or hay bales once it has reached on-third of the exposed height of the control.

**2. <u>Stormwater management</u>.** Any action that will expand, recondition, reconstruct, or replace pavement, replace a stream crossing, otherwise increase the contributing impervious surface within the project area, or create a new stormwater conveyance or discharge facility, must have a stormwater management plan that is developed and carried out by the applicant, commensurate with the scale of the action.

**3. <u>Site restoration</u>.** Any action that results in significant disturbance of riparian vegetation, soils, streambanks, or stream channel must have a site restoration plan that is developed and carried out by the permittee (or Corps), that is commensurate with the scale of the action. The goal of the plan is to ensure that riparian vegetation, soils, streambanks, and stream channel are cleaned up and restored after the action is complete. No single criterion is sufficient to measure restoration success, but the intent is that the following features should be present in the upland parts of the project area, within reasonable limits of natural and management variation:

a. Human and livestock disturbance, if any, are confined to small areas necessary for access or other special management situations.

b. Areas with signs of significant past erosion are completely stabilized and healed, bare soil spaces are small and well-dispersed.

c. Soil movement, such as active rills and soil deposition around plants or in small basins, is absent or slight and local.

d. Native woody and herbaceous vegetation, and germination microsites, are present and well distributed across the site.

e. Plants are native species and have normal, vigorous growth form, and a high probability of remaining vigorous, healthy and dominant over undesired competing vegetation.

f. Vegetation structure is resulting in rooting throughout the available soil profile.

g. Plant litter is well distributed and effective in protecting the soil with little or no litter accumulated against vegetation as a result of active sheet erosion ("litter dams").

h. A continuous corridor of shrubs and trees appropriate to the site are present to provide shade and other habitat functions for the entire streambank.

i. Streambanks are stable, well vegetated, and protected at margins by roots that extend below baseflow elevation, or by coarse-grained alluvial debris.

**4. Compensatory mitigation.** Any action that will permanently displace riparian or aquatic habitats or otherwise prevent development of properly functioning condition of natural habitat processes will require compensatory mitigation to fully offset those impacts.

a. Examples of actions requiring compensatory mitigation include construction of a new or enlarged boat ramp or float, the addition of scour protection to a boat ramp, or construction of new impervious surfaces without adequate stormwater treatment.

b. For displaced riparian and aquatic habitat, the primary habitat functions of concern are related to the physical and biological features essential to the long-term conservation of listed species. Those are water quality, water quantity, channel substrate, floodplain connectivity, forage, natural cover, space, and free passage. Examples of acceptable mitigation for riparian losses includes planting trees or other woody vegetation in the riparian area, removal of existing overwater structures or restoration of shallow-water, off-channel, or beach habitat by adding features such as submerged or overhanging large wood, aquatic vegetation, large rocks and boulders, side channels and undercut banks.

c. For new impervious surfaces with inadequate stormwater treatment, the primary habitat functions of concern are water quality and water quantity. Examples of acceptable mitigation for inadequate stormwater management includes providing adequate stormwater treatment at an alternate site where it did not exist before or retrofitting an existing but substandard stormwater facility to provide capacity necessary to infiltrate and retain the proper volume of stormwater.

d. As part of NMFS's review under clause 3 above, NMFS will determine if the proposed compensatory mitigation fully offsets permanent displacement of riparian or aquatic habitats and/or impacts that prevent development of properly functioning processes.

**5. Preconstruction activity.** Before alteration of the action area, flag the boundaries of clearing limits associated with site access and construction to minimize soil and vegetation disturbance, and ensure that all temporary erosion controls are in place and functional.

**6. Site preparation.** During site preparation, conserve native materials for restoration, including large wood, vegetation, topsoil and channel materials (gravel, cobble and boulders) displaced by construction. Whenever practical, leave native materials where they are found and in areas to be cleared, clip vegetation at ground level to retain root mass and encourage reestablishment of native vegetation. Building and related structures may not be constructed inside the riparian management area.

**7. Heavy equipment.** Heavy equipment will be selected and operated as necessary to minimize adverse effects on the environment (*e.g.*, minimally-sized, low pressure tires,



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minimal hard turn paths for tracked vehicles, temporary mats or plates within wet areas or sensitive soils); and all vehicles and other heavy equipment will be used as follows:

a. Stored, fueled and maintained in a vehicle staging area placed 150 feet or more from any waterbody, or in an isolated hard zone such as a paved parking lot.

b. Inspected daily for fluid leaks before leaving the vehicle staging area for operation within 50 feet of any waterbody.

c. Steam-cleaned before operation below ordinary high water, and as often as necessary during operation to remain free of all external oil, grease, mud, seeds, organisms and other visible contaminants.

d. Generators, cranes and any other stationary equipment operated within 150 feet of any waterbody will be maintained and protected as necessary to prevent leaks and spills from entering the water.

**8. In-water work period.** All work within the active channel will be completed in accordance with the WDFW- and NMFS-approved in-water work windows.

a. Hydraulic and topographic measurements and encased geotechnical drilling may be completed at any time, if a fish biologist determines that no adult fish are congregating for spawning and no redds are occupied by eggs or pre-emergent alevins within 300 feet of the work site.

**9. Actions that require work area isolation.** Any action that involves excavation (other than access management), backfilling, embankment construction, or similar work below ordinary high water where adult or juvenile fish are reasonably certain to be present, or 300 feet or less upstream from spawning habitats, must be effectively isolated from the active stream.

**10. Fish capture and removal.** Whenever work isolation is required and ESA-listed fish are likely to be present, the applicant must attempt to capture and remove the fish as follows:

a. A fishery biologist experienced with work area isolation and competent to ensure the safe capture, handling and release of all fish will supervise this part of the action, and complete the fish salvage form from Appendix C that will be submitted with the action completion report.

b. Any fish trapped within the isolated work area must be captured and released using a trap, seine, electrofishing, or other methods as prudent to minimize the risk of injury, then released at a safe release site.

c. If electrofishing is used to capture fish, that work must consistent with NMFS' electrofishing guidelines (NMFS 2000).

**11. Piling installation.** Pilings may be concrete, steel round pile 24 inches in diameter or smaller, steel H-pile designated as HP24 or smaller, or wood that has not been treated with preservatives or pesticides. Any proposal to use wood pilings treated with preservatives or pesticides is not covered by this consultation and will require individual consultation.

a. When practical, use a vibratory hammer for piling installation. For pile driving in the Columbia River in the month of October, only a vibratory hammer may be used.

b. Jetting may be used for piling installation in areas with coarse, uncontaminated sediments.

**12. <u>Pile driving with an impact hammer</u>.** When using an impact hammer to drive or proof steel piles, one of the following sound attenuation methods must be used:

a. Completely isolate the pile from flowing water by dewatering the area around the pile.

b. If water velocity is 1.6 feet per second or less, surround the piling being driven by a confined or unconfined bubble curtain (*see*, Wursig *et al*. 2000, and Longmuir and Lively 2001) that will distribute small air bubbles around 100% of the piling perimeter for the full depth of the water column.

c. If water velocity is greater than 1.6 feet per second, surround the piling being driven by a confined bubble curtain (*e.g.*, a bubble ring surrounded by a fabric or non-metallic sleeve) that will distribute air bubbles around 100% of the piling perimeter for the full depth of the water column.

**13. <u>Pile removal</u>.** Use the following steps to minimize creosote release, sediment disturbance and sediment resuspension:

a. Install a floating surface boom to capture floating surface debris.

b. Keep all equipment (*e.g.*, bucket, steel cable, vibratory hammer) out of the water, grip piles above the waterline, and complete all work during low water and low current conditions.

c. Dislodge the piling with a vibratory hammer, when possible; never intentionally break a pile by twisting or bending.

d. Slowly lift the pile from the sediment and through the water column.

e. Place the pile in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment – a containment basin for the removed piles and any adhering sediment may be constructed of durable

plastic sheeting with sidewalls supported by hay bales or another support structure to contain all sediment and return flow which may otherwise be directed back to the waterway.

f. Fill the holes left by each piling with clean, native sediments immediately upon removal.

g. Dispose of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

**5. <u>Broken or intractable piling</u>.** When a pile breaks or is intractable during removal, continue removal as follows:

a. Make every attempt short of excavation to remove each piling, if a pile in uncontaminated sediment is intractable, breaks above the surface, or breaks below the surface, cut the pile or stump off at least 3 feet below the surface of the sediment.

b. If dredging is likely where broken piles are buried, use a global positioning system (GPS) device to note the location of all broken piles for future use in site debris characterization.

**6. <u>Pesticide-treated wood installation.</u>** Use of lumber, pilings, or other wood products treated or preserved with pesticidal compounds may not be used below ordinary high water, or as part of an in-water or overwater structure

**7. <u>Pesticide-treated wood removal</u>.** When it is necessary to remove pesticide-treated wood, the following conditions apply.

a. Ensure that, to the extent possible, no wood debris falls into the water. If wood debris does fall into the water, remove it immediately.
b. After removal, place wood debris in an appropriate dry storage site until it can be removed from the project area.
c. Do not leave wood construction debris in the water or stacked on the streambank at or below the ordinary high water.
d. Evaluate wood construction debris removed during a project, including pesticide- treated wood pilings, to ensure proper disposal of debris.

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