Endangered Species Act - Section 7 Consultation
Biological Opinion

Mud Mountain Dam Maintenance and Operations
and
Replacement of the White River (Buckley) Barrier Dam
U.S. Fish and Wildlife No. 1-3-05-F-0517

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Consultation Conducted By: U.S. Fish and Wildlife Service
Western Washington Fish and Wildlife Office

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CONSULTATION HISTORY

The U.S. Army Corps of Engineers (Corps) initially requested consultation on the maintenance and operations for the Mud Mountain Dam (MMD) facility on December 27, 2001 (FWS Ref # 1-3-02-F-0569), in response to the listing of bull trout. The Corps later withdrew their request based in part on workload and priorities of the agencies.

A revised consultation package was received on June 30, 2005, and consultation was initiated on the same date. In addition to the maintenance and operation of MMD, the revised consultation package also included replacement of the antiquated Buckley Dam with another low-head dam to support the Corps' fish trap-and-haul facility co-located with the existing structure, based on MMD maintenance and operation needs related to Puget Sound Energy's (PSE) decision to discontinue operation of their hydroelectric facility on Lake Tapps. The Corps proposed determinations of "may affect, likely to adversely affect" for bull trout (*Salvelinus confluentus*) and bald eagle (*Haliaeetus leucocephalus*) and "no effect" for the marbled murrelet (*Brachyramphus marmoratus*), northern spotted owl (*Strix occidentalis caurina*), grizzly bear (*Ursus arctos horribilis*), gray wolf (*Canis lupus*), and Canada lynx (*Lynx canadensis*). The Corps proposed a determination of "not likely to adversely modify" for proposed bull trout critical habitat. After bull trout critical habitat was designated (70 FR 56212 [September 26, 2005]) the Corps revised their determination to "may affect, likely to adversely affect" via email on June 1, 2007. A complete record of this consultation is on file with the U.S. Fish and Wildlife Service's (Service) Western Washington Fish and Wildlife Office located in Lacey, Washington.

This Biological Opinion (Opinion) is based on information provided in the June 30, 2005, Biological Assessment, and additional sources including the following:

- Written and verbal communications with the Corps, including, but not limited to:
  - Modifications to the new Buckley Dam design and associated facilities received from the Corps via email on March 9, 2006 and June 4, 2007.
  - Multiple site visits to the Mud Mountain Dam and Buckley fish trap facilities.
- Conversations and/or coordination with staff from the National Marine Fisheries Service (NMFS), the Puyallup Tribe of Indians, the Muckleshoot Indian Tribe (MIT), Washington State Department of Fish and Wildlife (WDFW), Washington State Department of Ecology (WDOE), and the Service.
- Literature research and review of related topics.

BIOLOGICAL OPINION

This formal consultation addresses the maintenance and operations of MMD, located at river mile (RM) 30 of the White River, near Enumclaw, Pierce County, Washington (Figure 1). The proposed action includes maintenance and operations of MMD for the next 5 years, and would occur at two sites: 1) the MMD facility proper, and 2) the Corps' fish passage mitigation site for MMD—a trap-and-haul facility approximately 5.5 miles downstream of MMD at RM 24.3 of the White River near Buckley, Washington (Figure 2). To facilitate continued operation of the fish trap, the Corps also proposes to replace the existing antiquated flashboard diversion dam at Buckley with a larger, concrete fish barrier dam in the same location. A significant portion of the proposed action would occur at the downstream location, and would include the following construction activities:

- Replace the existing diversion dam at Buckley.
- Replace the Corps' existing fish trap-and-haul facility on the south bank of the White River with a new, upgraded facility with sorting capabilities to eliminate use of nets and reduce or eliminate handling impacts during fish capture activities.
- Provide minor upgrades to the intake of the existing MIT White River fish trap on the north bank of the White River to facilitate increased fish returns to the MIT fish trap when the Corps' fish passage operations are temporarily transferred to this facility during replacement of the Buckley Dam.

1.0 HISTORY OF THE PROJECT

Mud Mountain Dam is an earthen structure located in a steep and narrow gorge at RM 30 of the White River. The facility was authorized by the Flood Control Act of June 22, 1936, and was planned to be the main unit of the comprehensive Puyallup River flood control project. Construction was initiated in 1939, and then temporarily delayed due to the start of World War II. The project resumed in 1947 and was completed in 1948. This dam was constructed for the sole purpose of controlling floods in the lower White and Puyallup River valleys. During peak flow events (generally between November and March), the dam provides flood protection to the homes, businesses, and infrastructure for about 400,000 people in Pierce County, including those living in the cities of Enumclaw, Buckley, Auburn, Sumner, and Tacoma. The facility does not maintain a reservoir for hydroelectric generation, recreation, or any other similar use.

Mud Mountain Dam regulates flooding in the White and lower Puyallup River basins by temporarily retaining water and attenuating flows from heavy rains and melting snow from Mount Rainier. The dam controls 42 percent of the flow in the Puyallup Basin; consequently, flow reductions required at MMD may be substantial depending on the magnitude of a given flood event. Flood damage to developed and/or occupied areas generally begins to occur when flows approach 6,500 cubic feet per second (cfs). However, major damage to structures and property in the lower White River is reported to occur at 12,000 cfs; to avoid major damage to these areas, MMD provides a controlled release of flows that generally does not exceed 12,000 cfs. The channel capacity of the lower Puyallup River is 50,000 cfs. The facility attenuates flood flows to maintain a maximum flow of 45,000 cfs in the Puyallup River, with the lesser target volume providing a degree of protection from forecasting errors. Evacuation of the temporary reservoir storage begins after precipitation forecasts indicate a falling trend in the flow at Puyallup and a discharge below the 45,000 cfs control flow for at least 2 consecutive hours, and continues until normal flows are achieved. Flood flows are sometimes disseminated relatively quickly to allow for subsequent precipitation/flooding events and associated flood control.

The current configuration and operation of the dam generally allows in-flows to match out-flows of water ("run-of-the-river") during non-flood events. Two steel-lined tunnels (with 9- and 23-ft widths, respectively) allow for passage of water, fish, small woody debris, and sediment through the dam (Figure 3). The smaller 9-ft tunnel is used primarily for run-of-the-river flows. A 23-ft tunnel can also be brought on-line to create additional flow-through capacity for MMD, but can only be used when the reservoir elevation is above 910.5 ft[1]. The 23-ft tunnel may operate independently when necessary (e.g., during maintenance of the 9-ft tunnel), and has two intake points situated at different vertical locations above the intake to the 9-ft-wide tunnel.

1.1 Fish Trap-and-Haul Facility

Maintenance and operations of MMD includes activities conducted at the Corps fish trap-and-haul facility located on the south bank of the White River approximately 5.5 miles downstream of MMD at Buckley, Washington. The Corps entered into an agreement with Puget Sound Power and Light (precursor of PSE) in 1948 to construct a fish trap-and-haul facility co-located with the energy company's diversion dam (described below) at this location. The Corps operates the fish collection facility to provide fish passage around MMD as mitigation for the complete upstream migration barrier created by the flood control dam, which has no fish ladder or alternate passage route for migratory fish. The pool created behind the diversion dam, presently owned by PSE, is integral to the operation of the Corps' existing fish trap-and-haul facility, providing attraction flows to the Corps fish ladder and trap (and to the MIT fish trap on the north bank).

The Corps has indicated that construction of an upstream fish bypass facility (e.g., fish ladder) at MMD to eliminate the complete upstream fish barrier created by MMD is impracticable due to the dam's earthen construction and location within extremely steep canyon walls. The Corps has instead proposed to replace the existing trap-and-haul facility adjacent to its existing location at Buckley. A full description of the final design for the Buckley Dam and replacement fish trap is not yet available because the design phase has only recently been initiated, although revised interim plans (35 percent) were received on June 4, 2007. However, the proposed replacement fish trap will include a sorting facility to reduce or eliminate the need for netting/handling of fish (described in greater detail below and in subsequent sections) and will occur in conjunction with the replacement of the Buckley Dam. The Corps has committed to coordination with the Service and NMFS in the design and implementation of the replacement fish trap, to ensure the finalized design would not cause an adverse effect to listed species or critical habitat in a manner or to an extent not considered in this Opinion. Should the design not meet this standard, the action agency would need to reinitiate consultation with the Service.

[1] The reservoir elevation may range from 859 mean sea level (empty) to 1,257 ft mean sea level (full), although the maximum value has not been reached to date.

At the existing fish trap, salmonids navigate a series of fish ladder weirs to the entrance of a holding pond composed of a basket formed by wooden slats (braille) (Figure 4). The basket is raised mechanically and fish are crowded together as the water depth decreases. The fish then swim from the holding pool into a steel hopper, with a technician identifying and counting each fish as it swims into the hopper. The hopper is raised and evacuated directly into the fish transport truck with a water-to-water transfer of fish (Figure 5). The fish are then transported approximately 4 miles upstream of MMD where they are released through a wetted chute into the White River (Figure 6). The transport truck is equipped with aeration devices and temperature monitors to improve survival of transported fish. The operation of the trap-and-haul facility, including associated transportation of captured fish, lasts approximately 1 to 2 hours. Fish accessing the trap are captured and transported daily during periods of high return, or may remain in the trap for up to several days during periods of low returns.

Eight species of salmonids have been captured in the Corps fish trap, including bull trout, Chinook (*Oncoryhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), sockeye (*O. nerka*) and pink (*O. gorbuscha*) salmon, steelhead/rainbow trout (*O. mykiss*), and cutthroat trout (*O. clarki*). Most salmon, trout, and char are transported and released upstream, with two exceptions: hatchery steelhead and hatchery Chinook. All hatchery steelhead are released back downstream per an agreement with the MIT and WDFW (Marks et al. 2006). During Chinook returns (generally late May to early October), fish are hand-sorted with nets at the trap before the release of non-hatchery Chinook upstream of MMD. Much of the hand-sorting is conducted by Tribal fisheries staff to separate and retain hatchery stock Chinook salmon from wild Chinook salmon and other salmonids. During hand-sorting activities, salmonids are typically dip-netted out of the holding pond into a tank stationed nearby or to an operator who places the non-hatchery fish in the transport truck. To reduce impacts to captured fish from handling and to more efficiently process increasing numbers of fish, netting activities are generally suspended over late summer/fall as hatchery Chinook numbers decrease and pink salmon begin returning in large numbers.

Bull trout often arrive during the same time of year as Chinook salmon and would be netted and handled during the sorting process during this time. Under separate scientific studies conducted by the Puyallup Tribe and others, some bull trout have been tagged before being released above MMD (e.g., Marks et al. 2006). The handling of fish for the purpose of scientific studies at this facility has been covered under a section 10(a)(1)(A) permit, which in itself is covered under regional programmatic consultation #TE049004-4; however, the entrainment of bull trout in the Corps' fish trap, the associated transport of bull trout by the Corps to the release site above MMD, and other associated impacts to bull trout as a result of any Corps maintenance and operations at MMD facilities and/or the Buckley Dam have not been covered under this or any other permit.

2.0 DESCRIPTION OF PROPOSED ACTION

The following paragraphs provide a general overview of the actions currently proposed by the Corps, and cover maintenance and operation activities for MMD. These activities would occur both at MMD and at the downstream fish trap facility. Additionally, replacement of the diversion dam with a fish barrier dam and construction of a new, upgraded Corps fish trap is proposed to facilitate future maintenance and operations at the fish trap. For clarity, this section will be divided as follows:

- Maintenance and operation activities at MMD
- Maintenance and operation activities at the Corps fish trap-and-haul facility
- Replacement of the Buckley Dam and Corps fish trap

2.1 Maintenance and Operations at Mud Mountain Dam

Maintenance and operations at MMD include a number of ongoing and future actions that are expected to require the manipulation of water levels upstream and downstream of MMD and/or the flows passing through the dam. Water levels in the reservoir may be manipulated for flood control, or during repair or maintenance. Both steel-lined tunnels periodically require maintenance (e.g., replacement of worn and/or abraded steel and concrete lining). Flows through MMD may also be reduced to enable repair and maintenance of the existing or replacement Buckley Dam or of PSE's facilities (diversion flume and gate). Also, lower flows may be necessary to facilitate search and rescue efforts on the White River downstream of MMD. Finally, high water levels behind the dam may be periodically and temporarily maintained to enable collection and stockpiling of woody debris above MMD to prevent clogging of the facility's intake structure and trash racks by debris too large to pass through the tunnels.

2.2 Maintenance and Operations at the Corps Fish Trap-and-Haul Facility

Activities associated with operation and maintenance of the fish trap facilities would occur at the trap (adjacent to the existing Buckley Dam) and/or at the fish release site upstream of Mud Mountain Dam. Maintenance and operation activities covered under this consultation may differ depending upon the timing of the construction/replacement of the Buckley Dam.

Prior to construction, future fish trap-and-haul facility activities would be similar to present operations. Periodic closures of varying duration at the Corps' fish trap would occur during demolition and construction of the new dam and replacement Corps fish trap, or as other modifications require temporary cessation of activities. In such an instance, the Corps would continue to fulfill their fish passage obligations by temporarily transferring fish trap operations to the MIT facility on the north bank of the White River. To reduce the likelihood of overwhelming the smaller MIT facility with potentially high numbers of fish, transference of fish passage operations during construction would be planned to coincide with periods of low fish returns to the area. During the replacement of the Corps fish trap, longer and less predictable closures may be needed. When construction of the new dam and Corps fish trap facilities has been completed, trap-and-haul activities will be similar to existing activities except that all hand netting efforts would be discontinued, and trapped fish would be passed through the sorting facility and into holding pools to await transport upstream. Bull trout and other fish may continue to be sampled or otherwise studied under the permitting process described previously, but the Corps fish trap-and-haul operations are expected to be more efficient and would result in reduced handling stresses to captured fish.

2.3 Replacement of the Buckley Dam and Corps Fish Trap

The replacement of the existing structure includes a number of activities at the Buckley Dam and its appurtenant facilities (including the Corps fish trap and the MIT hatchery). In addition to the demolition of the existing dam and Corps fish trap, and construction of their replacements, a number of associated activities are planned, including upgrades to MIT's fish trap facility, new and/or improved access roads to the site (including a maintenance deck sited over the Buckley Dam), and north bank levee improvements. However, due to recent significant design revisions, finalized plans for the construction at the Buckley facilities are not yet available. The Corps has provided us with their latest interim (35 percent) design, although some details may further change during the planning process. The Corps has requested that we continue with the consultation in the absence of a finalized design, and has committed to coordinate with the Service and NMFS to ensure the finalized design would not cause an adverse effect to listed species or critical habitat in a manner or to an extent not considered in this Opinion. Should the design not meet this standard, the Corps would be required to reinitiate consultation with the Service. The following paragraphs describe these activities in general terms and are followed by a summary of the construction schedule.

2.3.1 Replacement of the Buckley Dam

The proposed action would include the construction of a new dam that spans the river channel (approximately 300 ft) with a concrete, fixed-crest weir and multiple steel radial gates to create a complete upstream fish barrier. During extreme high flow conditions when the weir overtops, the fixed-crest shape would prevent free discharge directly onto the spillway apron allowing for the safe downstream passage of subadult[2] salmonids. The shape and height of the weir are designed such that sufficient flow velocities develop along the downstream apron to create a velocity barrier to upstream fish passage. The dimensions of the apron would also be designed to prevent steelhead and other salmonids from upstream movement over the dam when overtopping flows exist. Flows are rarely expected to overtop the dam, with most of the river flow directed downstream through the gates and fish trap facility. The gate and weir design is expected to maintain a pool level behind the Buckley Dam[3] sufficient to provide water to the trap-and-haul facilities; dewatering of the fish trap would not occur due to operation procedures and/or design of the dam.

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[2] The similar terms "juvenile" and "subadult" are used to refer to relative non-adult life history stages of bull trout and other species. This Opinion will generally use the terms subadult and juveniles to refer to non-adult individuals in the action area, but these terms are not in reference to early rearing juveniles, as these individuals would be expected to remain in their natal streams until they began migrating downstream to the White River, Puyallup River, and/or Puget Sound.

[3] The new Buckley Dam and its associated upstream pool would also allow continued diversion of flows to Lake Tapps, although the Corps would not operate the diversion gates or flume, or directly determine the rate of flow through the diversion.

While the finalized design is not yet available, the current design indicates construction of several adjustable radial gates situated adjacent to the south bank near the existing Corps fish trap. The adjustable radial gates would allow mobilization and passage of sediment and debris that would otherwise accumulate in front of the diversion (and fish screen) intake, and would maintain water supply to the fish trap intake screen. The radial gates are also expected to enhance attraction flows to the Corps fish trap entrance downstream of the dam. An 8-ft-wide radial gate would be located on the south bank shoreline directly downstream from the water supply for the fish trap. A gate of intermediate width (e.g., 16-ft-wide) and multiple wider (e.g., 35-ft-wide) gates would occupy adjacent positions to the north of the 8-ft gate. Both the 8-ft and 16-ft gates would provide juvenile fish passage downstream.

A maintenance deck approximately 25-ft-wide would be constructed over the Buckley Dam to provide vehicular access across the structure. The purpose of this feature is to ensure efficient maintenance of gates, weirs, and other structures. In addition, the maintenance deck would provide access to either bank by serving as a bridge and would enable more timely transfer of hatchery and wild fish between facilities. To allow south bank access to the bridge, the existing fish trap would be demolished and the upgraded facility would be sited just downstream of its current position, resulting in additional encroachment into the channel.

2.3.2 Replacement of the Corps Fish Trap

The Corps' existing fish trap would remain operational during times of construction except for episodic closures or disruptions during replacement of the Buckley Dam, and an anticipated longer closure during demolition and construction of the new Corps fish trap. These closures would be timed as much as possible to coincide with periods of low fish usage and minimized in their duration as fish returns are temporarily redirected to the MIT hatchery.

The Corps is still analyzing and revising their designs for the new, upgraded facility. However, the Corps has committed to meeting the following performance standard(s) for the new fish trap:

- Upon completion of the new facility, attraction flows to the fish trap would not be interrupted, nor would the fish ladder or trap be allowed to dewater except during occasional maintenance operations. Maintenance operations are generally timed to occur during winter months, when bull trout would not be expected to enter the fish ladder.
- The Corps will design and construct the new facility such that 95 percent of upstream-migrating bull trout entering the trap are captured, transported, and released above MMD without mortality or injury, except when
    - Other approved (non-Corps/U.S. Department of Defense) staff sample fish for tagging, tissue samples, or other scientific purposes under a separate consultation or permit.
    - Bull trout are transported above MMD by entities other than the Corps.

The following performance standards would apply to both the existing and new Corps fish trap-and-haul facility:

- Adult fish transportation densities would be at or below 0.15 cubic feet/pound of fish based on a composite of returning adult weight.
- Adult holding pool densities would be at or below 0.25 cubic feet/pound of fish based on a composite of returning adult weight.
- The oxygen supply system in the transport vehicle would be maintained and operated properly. Oxygen supply to the tank would be maintained at or above 10 parts per million (ppm).
- The tanks would be kept clean and in working order.
- The water used to fill the transportation trucks will be of the same character as the fish trap. (The water source will be river water in the vicinity of the trap, and would be collected just prior to trap operations.)
- The fish release flume will be positioned between 3 to 5 ft above the water level.

2.3.3 MIT Hatchery Upgrades and Operation

The Corps plans to provide upgrades to the MIT facility to enable adequate fish passage during construction-related closures of the Corps fish trap. The north bank MIT facility currently does not have the capacity to accommodate the anticipated fish passage needs that are routinely managed by the larger Corps fish trap. Major improvements to the facility to support the Tribe's routine operations are not planned. The necessary upgrades to the MIT facility have not yet been selected, but may include the installation of a larger hopper, improved water flow to the facility, and improved entrance geometry. Selected upgrades will be finalized at a later date as the Corps continues to coordinate with the MIT, the Service, and NMFS.

In the absence of a finalized design, the Corps has proposed several performance standards to address some of the uncertainties associated with transfer of fish trap operations to the MIT facility. These include:

- At least 95 percent of bull trout will be passed above MMD without injury or mortality during periods when manual handling (i.e., nets) is not necessary for sorting fish, and/or when other entities are not collecting/tagging bull trout for studies under a separate consultation or permit.
- In the event of handling, operation procedures will be in place and approved by the Service and NMFS for handling salmonids at the MIT facility during construction.
- If netting is necessary, reservoir nets or other systems will be used to minimize handling stress.
- MIT facilities will only be used by the Corps during construction or until the Corps' fish trap facility is functioning.

- Adult fish transportation densities would be at or below 0.15 cubic feet/pound of fish based on a composite of returning adult weight.
- Adult holding pool densities would be at or below 0.25 cubic feet/pound of fish based on a composite of returning adult weight.
- The oxygen supply system in the transport vehicle would be maintained and operated properly. Oxygen supply to the tank would be maintained at or above 10 ppm.
- The tanks would be kept clean and in working order.
- The water used to fill the transportation trucks will be of the same character as the fish trap. (The water source will be river water in the vicinity of the trap, and would be collected just prior to trap operations.)
- The fish release flume will be positioned between 3 to 5 ft above the water level.

Additionally, the Corps will attempt to limit transfer of trap-and-haul operations to the MIT facility to periods when low returns of fish are expected, to the extent possible. While returns are sometimes difficult to predict, general trends for fish returns may assist in the scheduling and implementation of construction activities. However, due to the recent decision of the Corps to replace their fish trap with a new facility during construction (a decision supported by the Service and NMFS for the long-term benefits to listed species in this system), transfer of trap activities to the MIT facility may be required for a longer period of time than was originally intended. Depending on the length of time necessary to complete the new Corps fish trap, operations at the MIT facility may overlap with higher returns of salmonids. If this should occur, the Corps would likely implement other activities (e.g., increased staff and/or use of trucks, increased number of trips/day, etc.).

2.3.4 Access Road

An access road to the Buckley facilities site on the south bank is used for maintenance activities by both the Corps and PSE. The road will be resurfaced with gravel and graded in preparation for construction-related and routine use by vehicles and heavy equipment (Dillon, Corps, personal communication, June 4, 2007). A bridge that crosses the diversion flume (but not the White River or its tributaries) may also need to be upgraded to support use of the road. However, water quality impacts are not expected as a result of this activity.

2.3.5 Levee Upgrades

Operation of the new Buckley Dam may result in some degree of headwater rise during high flows compared to the existing condition. Flooding conditions at the MIT hatchery facility are sometimes observed at flood level flows, and upgrades to the existing north-bank levee are planned to ensure adequate protection for the hatchery. The levee upgrades would be designed to maintain a 2.5-ft freeboard for flood events (up to 12,000 cfs). The riverside slope of the levee would be faced with riprap to prevent erosion during high flow events, and the 12-ft wide crest of the levee would function as a service road along the right bank.

2.3.6 Summary of Construction Schedule

Construction would occur in two phases. In each phase, at least half of the White River's width would be temporarily isolated from the main channel by a cofferdam. Construction of the cofferdams would take place from July 15 to August 31, during a period of anticipated naturally high turbidity and low flows. The cofferdams would serve to protect the worksite during both demolition of the existing Buckley Dam and Corps fish trap and construction of the new facilities. While the final design of the cofferdam has not been decided, excessive seepage in the area to be excluded by the cofferdams may require a cutoff wall. The Corps would coordinate this and other design features with the Service and NMFS to avoid adverse impacts to listed species.

Construction within the cofferdams would occur in the dry through the fall and winter of each construction year, allowing downstream flows to be directed through new and/or existing conveyances (e.g., gates, fish ladders, etc.). The Corps has not yet determined the finalized schedule for construction, although some activities may begin as early as 2008. Construction will be divided into two phases, with work along each bank constituting a separate phase. Downstream fish passage is not expected to be interrupted during construction. For each phase of construction the following would occur:

- Preparatory work, staging, and other upland work (including access road work), which may begin in advance of the in-water work windows (July 15 to August 31).
- A cofferdam would be constructed across roughly one half of the stream to facilitate dismantling and replacement of the first half of the Buckley Dam. The proposed duration of construction in this phase (approximately 1 year) would require the coffer-dam to remain in place through the winter months in anticipation of continued dam construction through the following spring. Native fill and gravels would serve as the bulk of the cofferdam, although armor rock of varying sizes would be used to protect the structure from high flows. Sheet pile or non-permeable fabrics may be incorporated to control seepage and enhance stability.

  The footprint and makeup of the cofferdam would be designed against probable flood events common on the White River between November and April. The total estimated volumes of material for the cofferdams are:

  - <u>North bank:</u> approximately 1,143 cubic yards of fill and armor rock.
  - <u>South bank</u>: approximately 1,309 cubic yards of fill and armor rock.
- The area excluded by the cofferdam would be dewatered, and fish salvage operations would commence.
- Additional grading within the excluded area may be required to prepare a foundation for placement of concrete and steel/wood sub-structures within the cofferdam.
- All unusable right-bank dam features would be removed and disposed of in an approved upland location.

- Replacement of the dam components in each half of the river differs and will be installed in accordance with the finalized plans. On the north bank, a fixed crest gate and superstructure would be constructed on top of the foundation. On the south bank, radial gates, a fixed crest gate, and superstructure would be constructed on top of the foundation.
- The maintenance deck components would be constructed.
- MIT hatchery and levee upgrades would be installed.
- The existing repair infrastructure (crane system) would be removed.
- The cofferdam would be removed, with materials stockpiled for potential later use.
- The second phase of construction would begin, following a similar schedule on the opposite bank.
- When all construction has been completed, the Phase 2 cofferdam and associated armor rocks would be removed from the river channel.
- The timing of the demolition and relocation/construction of the new Corps fish trap has not yet been determined within this phased approach, but would occur during construction.

3.0 ACTION AREA

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment.

The action area for the proposed action includes all areas potentially affected by the maintenance and operation of MMD, including the replacement, maintenance, and operation of the Buckley Dam and the Corps fish trap (and associated release site) (Figure 7). The maintenance and operation of MMD, as defined above, does not include direct control by the Corps, of flow withdrawals through PSE's diversion flume to Lake Tapps via manipulation of the flume gate located just upstream of the existing Corps fish trap facility. However, the diversion of flows is made possible by the existence of the Buckley Dam. Consequently, the action area also includes reaches in and downstream of the diversion flume because 1) the flows through the diversion flume would not be feasible but for the presence of the Buckley Dam, and 2) fish present upstream of the Buckley Dam may access the diversion flume instead of passing through the Buckley Dam. Additionally, effects of the project attributable to flow, sediment movement, changes in channel geomorphology, and removal of large woody debris (LWD) from the system as a result of the proposed action are expected to propagate downstream to the mouth of the Puyallup River.

Therefore, the action area includes the following:

- The White River and riparian buffer zone from the upstream extent of the full pool of MMD (near the mouth of the Clearwater River) downstream to Commencement Bay, inclusive of the channel migration zone of the White River (related to aquatic impacts from construction, maintenance, and operations of the facilities). This portion of the action area also includes the diversion flume, Lake Tapps and the channel downstream of the non-operating hydropower facility below Lake Tapps.

- The White River at the fish release flume above Mud Mountain Dam (related to aquatic impacts from maintenance and operations of the fish haul operations).
- The upland portions of the project area within a 1 mile-radius of the fish trap-and-haul facility (related to terrestrial visual and sound disturbance from the Buckley Dam construction).

The aquatic and riparian portions of the action area would experience both short-term and long-term impacts from construction, operation, and maintenance of the facilities. Short-term disturbance and water quality impacts from construction would be limited to approximately 2 years (i.e., the duration of construction). Long-term impacts to aquatic and riparian habitat would be sustained as a result of the continued manipulation of flows, interruption of LWD, and other factors related to the maintenance and operation of MMD and its associated facilities.

Similarly, the upland portion of the action area would experience both short-term and long-term impacts. Short-term visual and sound disturbance would occur over approximately 2 years, and would result from the construction activities at the Buckley Dam, including but not limited to the potential use of pile driving and other heavy equipment, and an increase in frequency of transportation of materials to and from the site. Long-term disturbance would result from continued maintenance and operation of the facilities located at the site.

4.0 STATUS OF THE SPECIES: BULL TROUT

Listing Status

The coterminous United States population of the bull trout was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Cavender 1978; Bond 1992; Brewin and Brewin 1997; Leary and Allendorf 1997).

Throughout its range, the bull trout is threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Act relative to this species (64 FR 58910):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Current Status and Conservation Needs

In recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: 1) Jarbidge River, 2) Klamath River, 3) Columbia River, 4) Coastal-Puget Sound, and 5) St. Mary-Belly River (Service 2002; 2004a,b). Each of these interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

A summary of the current status and conservation needs of the bull trout within these interim recovery units is provided below and a comprehensive discussion is found in the Service's draft recovery plans for the bull trout (Service 2002; 2004a,b).

The conservation needs of bull trout are often generally expressed as the four "Cs": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations (a local population is a group of bull trout that spawn within a particular stream or portion of a stream system). The recovery planning process for bull trout (Service 2002; 2004a,b) has also identified the following conservation needs: 1) maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit, 2) preservation of the diversity of life-history strategies, 3) maintenance of genetic and phenotypic diversity across the range of each interim recovery unit, and 4) establishment of a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit (Rieman et al. 2003).

Central to the survival and recovery of bull trout is the maintenance of viable core areas (Service 2002; 2004a,b). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat. Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas recognized across the coterminous range of the bull trout (Service 2002; 2004a,b).

Jarbidge River Interim Recovery Unit

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawning adults, are estimated to occur in the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, incidental mortalities of released bull trout from recreational angling, historic angler harvest, timber harvest, and the introduction of non-native fishes (Service 2004b). The draft bull trout recovery plan (Service 2004b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout within the core area, 2) maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area, 3) restore and maintain suitable habitat conditions for all life history stages and forms, and 4) conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning bull trout per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (Service 2004b).

Klamath River Interim Recovery Unit

This interim recovery unit currently contains 3 core areas and 7 local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (Service 2002). Bull trout populations in this interim recovery unit face a high risk of extirpation (Service 2002). The draft Klamath River bull trout recovery plan (Service 2002) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and strategies, 4) conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to 15 new local populations and an increase in population size from about 2,400 adults currently to 8,250 adults are needed to provide for the persistence and viability of the 3 core areas (Service 2002).

Columbia River Interim Recovery Unit

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997). This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams (Idaho Department of Fish and Game in litt. 1995). The draft Columbia River bull trout recovery plan (Service 2002) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of the bull trout within core areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and 4) conserve genetic diversity and provide opportunities for genetic exchange.

This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good. All core areas have been subject to the combined effects of habitat degradation and fragmentation caused by the following activities: dewatering; road construction and maintenance; mining; grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The Service completed a core area conservation assessment for the 5-year status review and determined that, of the 97 core areas in this interim recovery unit, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, two are at low risk, and two are at unknown risk (Service 2005).

Coastal-Puget Sound Interim Recovery Unit

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous[4], adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this interim recovery unit. This interim recovery unit currently contains 14 core areas and 67 local populations (Service 2004a). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this interim recovery unit. Bull trout continue to be present in nearly all major watersheds where they likely occurred historically, although local extirpations have occurred throughout this interim recovery unit. Many remaining populations are isolated or fragmented and abundance has declined, especially in the southeastern portion of the interim recovery unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, poaching, incidental mortality from other targeted fisheries, and the introduction of non-native species. The draft Coastal-Puget Sound bull trout recovery plan (Service 2004a) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of bull trout within existing core areas, 2) increase

[4] As bull trout may move between fresh and salt water habitats several times during their lifetime, “amphidromous” may be a more accurate term to describe the behavior of bull trout migrating between fresh and salt water. Due to its more common usage, however, the term “anadromous” will be used in this opinion to describe the life history form of bull trout that access both of these areas.

bull trout abundance to about 16,500 adults across all core areas, and 3) maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River Interim Recovery Unit

This interim recovery unit currently contains six core areas and nine local populations (Service 2002). Currently, bull trout are widely distributed in the St. Mary River drainage and occur in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999. This increase was attributed primarily to protection from angler harvest (Service 2002). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (Service 2002). The draft St Mary Belly bull trout recovery plan (Service 2002) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and forms, 4) conserve genetic diversity and provide the opportunity for genetic exchange, and 5) establish good working relations with Canadian interests because local bull trout populations in this interim recovery unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989; Goetz 1989). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989; Goetz 1989), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978; McPhail and Baxter 1996; WDFW et al. 1997). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

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

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

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997).
Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993; Gilpin, *in litt.* 1997; Rieman et al. 1997). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Spruell et al. 1999; Rieman and McIntyre 1993). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat, as these fish are primarily found in colder streams (below 15 °C or 59 °F), and spawning habitats are generally characterized by temperatures that drop below 9 °C (48 °F) in the fall (Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1993).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Pratt 1992; Rieman and McIntyre 1993; Baxter et al. 1997; Rieman et al. 1997). Optimum incubation temperatures for bull trout eggs range from 2 °C to 6 °C (35 °F to 39 °F) whereas optimum water temperatures for rearing range from about 6 °C to 10 °C (46 °F to 50 °F) (McPhail and Murray 1979; Goetz 1989; Buchanan and Gregory 1997). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 °C to 9 °C (46 °F to 48 °F), within a temperature gradient of 8 °C to 15 °C (4 °F to 60 °F). In a landscape study relating bull trout distribution to maximum water temperatures, (Dunham et al. 2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11 °C to 12 °C (52 °F to 54 °F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman et al. 1997). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8 °C to 20 °C (46 °F to 68 °F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Bart Gamett, U.S. Forest Service, personal communication, June 20, 2002).

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

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

Migratory forms of bull trout may develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes or nearshore marine habitat where foraging opportunities may be enhanced (Frissell 1993; Goetz et al. 2004; Brenkman and Corbett 2005). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Rieman and McIntyre 1993; MBTSG 1998; Frissell 1999). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger size fish with higher fecundity is lost (Rieman and McIntyre 1993).

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, because this strategy can change as the fish progresses from one life stage to another (i.e., juvenile to subadult). Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994), and as fish grow, their foraging strategy changes as their food changes, in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987; Goetz 1989; Donald and Alger 1993). Subadult and adult migratory bull trout feed on various fish species (Leathe and Graham 1982; Fraley and Shepard 1989; Brown 1994; Donald and Alger 1993). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and Van Tassell 2001). In nearshore marine areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (WDFW et al. 1997; Goetz et al. 2004).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one source of food over another. For example, prey often occur in concentrated patches of abundance ("patch model;" Gerking 1994). As the predator feeds in one patch, the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005; Goetz et al. 2004).

<u>Changes in Status of the Coastal-Puget Sound Interim Recovery Unit</u>

Although the status of bull trout in Coastal-Puget Sound interim recovery unit has been improved by certain actions, it continues to be degraded by other actions, and it is likely that the overall status of the bull trout in this population segment has not improved since its listing on November

1, 1999. Improvement has occurred largely through changes in fishing regulations and habitat-restoration projects. Fishing regulations enacted in 1994 either eliminated harvest of bull trout or restricted the amount of harvest allowed, and this likely has had a positive influence on the abundance of bull trout. Improvement in habitat has occurred following restoration projects intended to benefit either bull trout or salmon, although monitoring the effectiveness of these projects seldom occurs. On the other hand, the status of this population segment has been adversely affected by a number of Federal and non-Federal actions, some of which were addressed under section 7 of the Act. Most of these actions degraded the environmental baseline; all of those addressed through formal consultation under section 7 of the Act permitted the incidental take of bull trout.

Section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans (HCPs) completed in the Coastal-Puget Sound population segment. These include: 1) the City of Seattle's Cedar River Watershed HCP, 2) Simpson Timber HCP, 3) Tacoma Public Utilities Green River HCP, 4) Plum Creek Cascades HCP, 5) Washington State Department of Natural Resources HCP, 6) West Fork Timber HCP (Nisqually River), and 7) Forest Practices HCP. These HCPs provide landscape-scale conservation for fish, including bull trout. Many of the covered activities associated with these HCPs will contribute to conserving bull trout over the long-term; however, some covered activities will result in short-term degradation of the baseline. All HCPs permit the incidental take of bull trout.

Changes in Status of the Columbia River Interim Recovery Unit

The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of actions addressed under section 7 of the Act. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and all permitted or analyzed the potential for incidental take of bull trout. The Plum Creek Cascades HCP, Plum Creek Native Fish HCP, and Forest Practices HCP addressed portions of the Columbia River population segment of bull trout.

Changes in Status of the Klamath River Interim Recovery Unit

Improvements in the Threemile, Sun, and Long Creek local populations have occurred through efforts to remove or reduce competition and hybridization with non-native salmonids, changes in fishing regulations, and habitat-restoration projects. Population status in the remaining local populations (Boulder-dixon, Deming, Brownsworth, and Leonard Creeks) remains relatively unchanged. Grazing within bull trout watersheds throughout the recovery unit has been curtailed. Efforts at removal of non-native species of salmonids appear to have stabilized the Threemile and positively influenced the Sun Creek local populations. The results of similar efforts in Long Creek are inconclusive. Mark and recapture studies of bull trout in Long Creek indicate a larger migratory component than previously expected.

Although the status of specific local populations has been slightly improved by recovery actions, the overall status of Klamath River bull trout continues to be depressed. Factors considered threats to bull trout in the Klamath Basin at the time of listing – habitat loss and degradation caused by reduced water quality, past and present land use management practices, water diversions, roads, and non-native fishes – continue to be threats today.

<u>Changes in Status of the Saint Mary-Belly River Interim Recovery Unit</u>

The overall status of bull trout in the Saint Mary-Belly River interim recovery unit has not changed appreciably since its listing on November 1, 1999. Extensive research efforts have been conducted since listing, to better quantify populations of bull trout and their movement patterns. Limited efforts in the way of active recovery actions have occurred. Habitat occurs mostly on Federal and Tribal lands (Glacier National Park and the Blackfeet Nation). Known problems due to instream flow depletion, entrainment, and fish passage barriers resulting from operations of the U.S. Bureau of Reclamation's Milk River Irrigation Project (which transfers Saint Mary River water to the Missouri River Basin) and similar projects downstream in Canada constitute the primary threats to bull trout and to date they have not been adequately addressed under section 7 of the Act. Plans to upgrade the aging irrigation delivery system are being pursued, which has potential to mitigate some of these concerns but also the potential to intensify dewatering. A major fire in August, 2006 severely burned the forested habitat in Red Eagle and Divide Creeks, potentially affecting three of nine local populations and degrading the baseline.

5.0 STATUS OF BULL TROUT IN THE PUYALLUP CORE AREA

The Puyallup core area comprises the Puyallup, Mowich, and Carbon Rivers; the White River system, which includes the Clearwater, Greenwater, and the West Fork White Rivers; and Huckleberry Creek. Glacial sources in several watersheds drain the north and west sides of Mount Rainier and significantly influence water, substrate, and channel conditions in the mainstem reaches. The location of many of the basin's headwater reaches within Mount Rainier National Park and designated wilderness areas (Clearwater Wilderness, Norse Peak Wilderness) provides relatively pristine habitat conditions in these portions of the watershed.

Anadromous, fluvial, and potentially resident bull trout occur within local populations in the Puyallup River system. Bull trout occur throughout most of the system although spawning occurs primarily in the headwater reaches. Anadromous and fluvial bull trout use the mainstem reaches of the Puyallup, Carbon, and White Rivers to forage and overwinter, while the anadromous form also uses Commencement Bay and likely other nearshore areas within Puget Sound. Habitat conditions within the lower mainstem Puyallup and White Rivers have been highly degraded, retaining minimal instream habitat complexity. In addition, habitat conditions within Commencement Bay and adjoining nearshore areas have been severely degraded as well, with very little intact intertidal habitat remaining.

The Puyallup core area has the southernmost, anadromous bull trout population in the Puget Sound Management Unit (Service 2004a). Consequently, maintaining the bull trout population in this core area is critical to maintaining the overall distribution of migratory bull trout in the management unit.

The status of the bull trout core area population is based on four key elements necessary for long-term viability: 1) number and distribution of local populations, 2) adult abundance, 3) productivity, and 4) connectivity (Service 2004a).

Number and Distribution of Local Populations

Five local populations occur in the Puyallup core area: 1) Upper Puyallup and Mowich Rivers, 2) Carbon River, 3) Upper White River, 4) West Fork White River, and 5) Greenwater River. The Clearwater River is identified as a potential local population, as bull trout are known to use this river and it appears to provide suitable spawning habitat, but the occurrence of reproduction there is unknown (Service 2004a).

Information about the distribution and abundance of bull trout in this core area is limited because observations have generally been incidental to other fish species survey work. Spawning occurs in the upper reaches of this basin where higher elevations produce the cold water temperatures required by bull trout egg and juvenile survival. Based on current survey data, bull trout spawning in this core area occurs earlier in the year (i.e., September) than typically observed in other Puget Sound core areas (Marks et al. 2002). The known spawning areas in local populations are few in number and not widespread. The majority of spawning sites are located in streams within Mount Rainier National Park, with two exceptions, Silver Creek and Silver Springs (Marks et al. 2002; R. Ladley, Puyallup Tribe, Tacoma, Washington, *in litt*. 2006). Rearing likely occurs throughout the Upper Puyallup, Mowich, Carbon, Upper White, West Fork White, and Greenwater Rivers. However, sampling indicates most rearing is confined to the upper reaches of the basin. The mainstem reaches of the White, Carbon, and Puyallup Rivers probably provide the primary freshwater foraging, migration, and overwintering habitat for migratory bull trout within this core area.

With fewer than 10 local populations, the Puyallup core area is considered to be at intermediate risk of extirpation and adverse effects from random naturally occurring events.

Adult Abundance

Rigorous abundance estimates are generally not available for local populations in the Puyallup core area. Currently, fewer than 100 adults probably occur in each of the local populations in the White River system, based on adult counts at Mud Mountain Dam's Buckley Diversion fish trap. Although these counts may not adequately account for fluvial migrants that do not migrate downstream of the facility, these counts do indicate few anadromous bull trout and few mainstem fluvial bull trout return to local populations in the White River system. Therefore, the bull trout population in the Puyallup core area is considered at increased risk of extirpation until sufficient information is collected to properly assess adult abundance in each local population.

Productivity

Due to the current lack of long-term, comprehensive trend data, the bull trout population in the Puyallup core area is considered at increased risk of extirpation until sufficient information is collected to properly assess productivity.

Connectivity

Migratory bull trout are likely present in most local populations in the Puyallup core area. However, the number of adult bull trout expressing migratory behavior within each local population appears to be very low compared to other core areas. Although connectivity between the Upper Puyallup and Mowich Rivers local population and other Puyallup core area local populations was reestablished with the creation of an upstream fish ladder at Electron Dam in 2000, this occurred after approximately 100 years of isolation. Very low numbers of migratory bull trout continue to be passed upstream at the Mud Mountain Dam's Buckley Diversion fish trap. The overall low abundance of migratory life history forms limits the possibility for genetic exchange and local population refounding, as well as limits more diverse foraging opportunities to increase size of spawners and therefore, overall fecundity within the population. Consequently, the bull trout population in the Puyallup core area is at intermediate risk of extirpation from habitat isolation and fragmentation.

Changes in Environmental Conditions and Population Status

Since the bull trout listing, the Service has issued Biological Opinions that exempted incidental take in the Puyallup core area. These incidental take exemptions were in the form of harm and harassment, primarily from hydrologic impacts associated with increased impervious surface, temporary sediment increases during in-water work, habitat loss or alteration, and handling of fish. None of these projects were determined to result in jeopardy to bull trout. The combined effects of actions evaluated under these Biological Opinions have resulted in short-term and long-term adverse effects to bull trout and degradation of bull trout habitat within the core area.

Of particular note, in 2003 the Service issued a Biological Opinion (FWS Ref. No. 1-3-01-F-0476) on the State Route 167 North Sumner Interchange Project. This project was located in Pierce County in the White River portion of the Puyallup watershed and was proposed by Washington State Department of Transportation. The project's direct and indirect impacts and cumulative impacts within the action area included urbanization of approximately 600 acres of land. We anticipated that conversion of this land to impervious surface would result in the permanent loss and/or degradation of aquatic habitat for bull trout and their prey species through reduced base flows, increased peak flows, increased temperatures, loss of thermal refugia, degradation of water quality, and the degradation of the aquatic invertebrate community and those species dependent upon it (bull trout prey species). These impacts will result in thermal stress and disrupt normal behavioral patterns. Incidental take of fluvial, adfluvial, and anadromous bull trout in the form of harassment due to thermal stress and the disruption of migrating and foraging behaviors was exempted for this project. These adverse effects were expected to continue in perpetuity.

Section 10(a)(1)(B) permits have also been issued for HCPs that address bull trout in this core area. Although these HCPs may result in both short and/or long-term negative effects to bull trout and their habitat, the anticipated long-term beneficial effects are expected to maintain or improve the overall baseline status of the species. Additionally, capture and handling, and indirect mortality, during implementation of section 6 and section 10(a)(1)(A) permits have directly affected some individual bull trout in this core area.

The number of non-Federal actions occurring within the Puyallup core area since the bull trout were listed is unknown. However, activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance affect riparian and instream habitat which typically results in negative affects to bull trout and their habitat.

Threats

Threats to bull trout in the Puyallup core area include:

- Extensive past and ongoing timber harvest and harvest-related activities, such as road maintenance and construction, continue to affect bull trout spawning and rearing areas in the upper watershed.

- Agricultural practices, such as bank armoring, riparian clearing, and non-point discharges of chemical applications continue to affect foraging, migration, and overwintering habitats for bull trout in the lower watershed.

- Dams and diversions have significantly affected migratory bull trout in the core area. Until upstream passage was recently restored, the Electron Diversion Dam isolated bull trout in the Upper Puyallup and Mowich Rivers local population for nearly 100 years and has drastically reduced the abundance of migratory bull trout in the Puyallup River. Buckley Diversion and Mud Mountain Dam have significantly affected the White River system in the past by impeding or precluding adult and juvenile migration and degrading foraging, migration, and overwintering habitats in the mainstem. Despite improvements to these facilities, passage related impacts continue today but to a lesser degree.

- Urbanization, road construction, residential development, and marine port development associated with the city of Tacoma, have significantly reduced habitat complexity and quality in the lower mainstem rivers and associated tributaries, and have largely eliminated intact nearshore foraging habitats for anadromous bull trout in Commencement Bay.

- The presence of brook trout (*Salvelinus fontinalis*) in many parts of the Puyallup core area and their potential to increase in distribution, including into Mount Rainer National Park waters, are considered significant threats to bull trout. Because of their early maturation and competitive advantage over bull trout in degraded habitats, brook trout in the upper Puyallup and Mowich Rivers local population is of highest concern because of past isolation of bull trout and the level of habitat degradation in this area.

- Until the early 1990s, bull trout fisheries probably significantly reduced the overall bull trout population within this and other core areas in Puget Sound. Current legal and illegal fisheries in the Puyallup core area may continue to significantly limit recovery of the population because of the low numbers of migratory adults.

- Water quality has been degraded due to municipal and industrial effluent discharges resulting from development, particularly in the lower mainstem Puyallup River and Commencement Bay.

- Water quality has also been degraded by stormwater discharge associated with runoff from impervious surface. Impervious surface in the Puyallup watershed increased by 12 percent between 1990 and 2001 (Puget Sound Action Team 2007b).

- Major flood events in November 2006 significantly impacted instream habitats within the Puyallup River system. These events are assumed to have drastically impacted bull trout brood success for the year, due to significant scour and channel changes that occurred after peak spawning. Significant impacts to rearing juvenile bull trout were also likely, further impacting the future recruitment of adult bull trout.

- In November 2006, an 18,000 gallon diesel spill in the head waters of Spring Creek (C. Hebert, Service, Portland, Oregon, *in litt.* 2006), a bull trout spawning area of the Upper White River local population, likely impacted the available instream spawning habitat. The duration of ongoing contamination of instream habitats by residual diesel is unknown.

6.0 STATUS OF BULL TROUT CRITICAL HABITAT

This biological opinion does not rely on the regulatory definition of “destruction or adverse modification” of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service (No. 03-35279) to complete the following analysis with respect to critical habitat.

Legal Status

The Service published a final critical habitat designation for the coterminous United States population of the bull trout on September 26, 2005 (70 FR 56212); the rule became effective on October 26, 2005. The scope of the designation involved the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Rangewide, the Service designated 143,218 acres of reservoirs or lakes and 4,813 stream or shoreline miles as bull trout critical habitat (Table 1).

Table 1. Stream/shoreline distance and acres of reservoir or lakes designated as bull trout critical habitat by state.

	Stream/shoreline Miles	Stream/shoreline Kilometers	Acres	Hectares
Idaho	294	474	50,627	20,488
Montana	1,058	1,703	31,916	12,916
Oregon	939	1,511	27,322	11,057
Oregon/Idaho	17	27		
Washington	1,519	2,445	33,353	13,497
Washington (marine)	985	1,585		

Although critical habitat has been designated across a wide area, some critical habitat segments were excluded in the final designation based on a careful balancing of the benefits of inclusion versus the benefits of exclusion (see Section 3(5)(A) and Exclusions under Section 4(b)(2) in the final rule). This balancing process resulted in all proposed critical habitat being excluded in 9 proposed critical habitat units: Unit 7 (Odell Lake), Unit 8 (John Day River Basin), Unit 15 (Clearwater River Basin), Unit 16 (Salmon River Basin), Unit 17 (Southwest Idaho River Basins), Unit 18 (Little Lost River), Unit 21 (Upper Columbia River), Unit 24 (Columbia River), and Unit 26 (Jarbidge River Basin). The remaining 20 proposed critical habitat units were designated in the final rule. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation.

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (70 FR 56212). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. Critical habitat units generally encompass one or more core areas and may include foraging, migration, and overwintering (FMO) areas, outside of core areas, that are important to the survival and recovery of bull trout.

Because there are numerous exclusions that reflect land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments. These individual critical habitat segments are expected to contribute to the ability of the stream to support bull trout within local populations and core areas in each critical habitat unit.

The primary function of individual critical habitat units is to maintain and support core areas which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, MBTSG 1998); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Rieman and McIntyre 1993, Hard 1995, Healey and Prince 1995, MBTSG 1998); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Rieman and McIntyre 1993, Hard 1995, MBTSG 1998, Rieman and Allendorf 2001).

The Olympic Peninsula and Puget Sound Critical Habitat Units are essential to the conservation of amphidromous bull trout, which are unique to the Coastal-Puget Sound bull trout population. These critical habitat units contain nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain Primary Constituent Elements (PCEs) that are critical to adult and subadult foraging, overwintering, and migration.

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Note that only PCEs 1, 6, 7, and 8 apply to marine nearshore waters identified as critical habitat; and all except PCE 3 apply to FMO habitat identified as critical habitat.

The PCEs are as follows:

(1) Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32 to 72 ºF (0 to 22 ºC) but are found more frequently in temperatures ranging from 36 to 59 ºF (2 to 15 ºC). These temperature ranges may vary depending on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation.

(2) Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and instream structures.

(3) Substrates of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. This should include a minimal amount of fine substrate less than 0.25 inch (0.63 centimeter) in diameter.

(4) A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation.

(5) Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.

(6) Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.

(7) An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

(8) Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Critical habitat includes the stream channels within the designated stream reaches, the shoreline of designated lakes, and the inshore extent of marine nearshore areas, including tidally influenced freshwater heads of estuaries.

In freshwater habitat, critical habitat includes the stream channels within the designated stream reaches, and includes a lateral extent as defined by the ordinary high-water line. In areas where ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Bankfull elevation is the level at which water begins to leave the channel and move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. For designated lakes, the lateral extent of critical habitat is defined by the perimeter of the water body as mapped on standard 1:24,000 scale topographic maps.

In marine habitat, critical habitat includes the inshore extent of marine nearshore areas between mean lower low-water and minus 10 meters (m) mean higher high-water, including tidally influenced freshwater heads of estuaries. This refers to the area between the average of all lower low-water heights and all the higher high-water heights of the two daily tidal levels. The offshore extent of critical habitat for marine nearshore areas is based on the extent of the photic zone, which is the layer of water in which organisms are exposed to light. Critical habitat extends offshore to the depth of 33 ft (10 m) relative to the mean lower low water.

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

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to “destroy or adversely modify” critical habitat by altering the PCEs to such an extent that critical habitat would not remain functional to serve the intended conservation role for the species (70 FR 56212, FWS 2004). The Service’s evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (Service and NMFS 1998). Therefore, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments.

Current Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). The depressed status of most core populations reflects the degraded condition of bull trout habitat rangewide.

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

Status of Critical Habitat Unit 28 (Puget Sound)

Critical Habitat has been designated for bull trout within the Coastal-Puget Sound interim recovery unit (70 FR 56212 [September 26, 2005]). The action area is located in Critical Habitat Unit 28, Puget Sound River Basins. The Puget Sound Critical Habitat Unit provides habitat conditions that are essential for diverse life history forms of bull trout; however, one of the unique conservation roles of the unit is that it supports anadromous bull trout. Therefore, it is one of only two Critical Habitat Units throughout the range of the species that support the anadromous life history form. This critical habitat unit contains nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult overwintering, migration, and foraging.

7.0 STATUS OF THE SPECIES: BALD EAGLE

A detailed account of the taxonomy, ecology, and reproductive characteristics of the bald eagle is presented in the Pacific Bald Eagle Recovery Plan (USDI 1986), the final rule to reclassify the bald eagle from endangered to threatened in all of the lower 48 states (USDI 1994), and the proposed rule to delist the bald eagle (USDI 1999). The most current information regarding bald eagles in Washington State and a detailed description of their biology and conservation can be found in the Washington State Status Report for the Bald Eagle (Stinson et al. 2001). A summary is provided below.

The bald eagle was federally listed in 1978 as an endangered species in all states except Michigan, Minnesota, Wisconsin, Washington, and Oregon, where it was designated as threatened (USDI 1978). The listing was a result of a decline in the bald eagle population throughout the lower 48 States. The decline was largely attributed to the widespread use of dichloro-diphenyl trichloro-ethane (DDT) and other organochlorine compounds, in addition to habitat loss, disturbance, shooting, electrocution from power lines, poisoning, and a decline in the food base.

The bald eagle was reclassified in 1995 from endangered to threatened as a result of a significant increase in the number of nesting pairs, increased productivity, and expanded distribution (USDI 1994). Since 1989 the bald eagle nesting population has increased at an average rate of approximately 8 percent per year (USDI 1999). The national average for fledglings per occupied breeding area is greater than one; therefore, the bald eagle population continues to increase. Certain geographically restricted areas, such as southern California, the Columbia River, the Great Lakes, and parts of Maine still have contaminant threats (USDI 1999). However, bald eagle recovery goals have generally been met or exceeded throughout its range (USDI 1999).

The delisting goals for the Pacific Recovery Area include 1) a minimum of 800 nesting pairs, 2) an average reproductive rate of 1.0 fledged young per occupied breeding area, with an average success rate for occupied breeding areas of not less than 65 percent over a 5-year period, 3) breeding population goals attained in at least 80 percent of management zones, and 4) wintering populations which are stable or increasing (USDI 1986).

In the Pacific Recovery Area population delisting goals have been met since 1995, the productivity objective of an average of 1.0 young per occupied breeding area has been met since 1990, and the average success rate for occupied breeding areas of 65 percent has been exceeded since 1994 (USDI 1999). However, as of 1999, the distribution objective among management zones had not yet been fully achieved.

Of the seven states covered in the Pacific Recovery Area, Washington State supports the largest breeding and wintering populations (USDI 1986). In 2001, 684 nest territories were occupied in Washington (WDFW *in litt.* 2003). Most nesting territories in Washington are located on the San Juan Islands, along the coastline of the Olympic Peninsula, along the Strait of Juan de Fuca, Puget Sound, Hood Canal, and the Columbia River. Wintering concentration areas in Washington are along salmon spawning streams and waterfowl wintering areas (Stinson et al. 2001).

Conservation Needs

<u>Habitat</u>

Nesting and wintering habitats are critical to the continued survival of the bald eagle (USDI 1999). Development-related habitat loss has been a significant threat to bald eagles in the Pacific Recovery Area of Washington, Idaho, Nevada, California, Oregon, Montana, and Wyoming (USDI 1994), although availability of habitat does not appear to be limiting bald eagle populations at this time (USDI 1999). Urban and recreational development, logging, mineral exploration and extraction, and other forms of human activities can adversely affect the suitability of breeding, wintering, and foraging habitat. While individual and small-scale actions may not appear to significantly affect the species as a whole, the cumulative long-term effects throughout the recovery area pose an important threat to the recovery of the species (USDI 1999).

Availability of suitable trees for nesting and perching is critical for maintaining bald eagle populations. The primary objective of the bald eagle recovery process is to provide secure habitat for bald eagles within the recovery area, and to increase population levels in specific geographic areas to the extent that the species can be delisted. Achieving the recovery goal of increasing the number of nesting pairs within the recovery area requires protection of existing habitat for breeding and wintering bald eagles, and restoring habitat that has been lost due to development or habitat modification.

Nesting Habitat

Suitable habitat for bald eagles is characterized by accessible foraging areas and trees that are large enough for nesting and roosting (Stalmaster 1987). Food availability, such as aggregations of waterfowl or salmon runs, is a primary factor attracting bald eagles to wintering areas and influences nest and territory distribution (Stalmaster 1987, Keister et al. 1987).

Bald eagles generally nest in the same territories each year and often use the same nest repeatedly, although alternate nests in the territory may be used as well. Bald eagle nests in the Pacific Recovery Area are usually located in uneven-age stands of coniferous trees with old-growth forest components (USDI 1986) that are located within 1 mile of large bodies of water (Stalmaster 1987). Factors such as relative tree height, diameter, tree species, form, position on the surrounding topography, distance from the water, and distance from disturbance influence nest site selection. Anthony and Isaacs (1989) found that bald eagles construct nests in Douglas-fir (*Pseudotsuga menziesii*) or Sitka spruce (*Picea sitchensis*) trees with an average diameter of 170.7 centimeters (cm) diameter breast height (DBH) and a height of 56.6 meters (m) in Douglas-fir forests, and an average diameter of 106.8 cm DBH and a height of 38.6 m in mixed-conifer forests. Suitable perch trees, which bald eagles use for guarding the nest, loafing, and foraging, are also a component of suitable nesting habitat (Stalmaster 1987, Buehler 2000).

Wintering Habitat

Wintering bald eagles typically congregate in large aggregations where, most importantly, food is abundant (See *Foraging*). Suitable perch sites adjacent to foraging areas and winter roost habitat are also necessary. In Washington, these criteria are typically met where waterfowl and salmon populations are present, as well as marine areas (Stinson et al. 2001).

When foraging, bald eagles select perches that provide an unobstructed view of the surrounding area, generally the tallest trees in the area. Tree species commonly used in Washington for perching in winter include black cottonwood (*Populus trichocarpa*), bigleaf maple (*Acer macrophyllum*), Douglas-fir, or Sitka spruce (Stalmaster and Newman 1979).

Wintering bald eagles often roost at communal sites which provide shelter during inclement weather. Bald eagles may roost communally in single trees or large forest stands of uneven ages. Bald eagles may remain at their daytime perches throughout the night as well, but typically gather at large communal roosts in the evening.

Communal night roosting sites are traditionally used year after year. Roost trees are usually the largest and have the most open structure (Keister and Anthony 1983, Watson and Pierce 1998a). They are often located in areas that provide a more favorable microclimate during inclement weather (Keister et al. 1985, Knight et al. 1983, Watson and Pierce 1998a). Prey sources may be available in the general vicinity, but for roosting, close proximity to food is not as critical as the need for shelter. In Washington, 26 roosts studied by Watson and Pierce (1998a) were all within 1,100 m of foraging areas. However, Stalmaster (1987), in reviewing a variety of studies found that only 40 percent were within 1 kilometer of water.

Human Disturbance

Human disturbance is a continuing threat, which may increase with increasing human populations and development (USDI 1999). Bald eagles vary in their sensitivity to disturbance, but generally nest away from human disturbance (Stinson et al. 2001). However, distance, duration, visibility and position of an activity affect bald eagle response, with distance being the most important factor (Grubb and King 1991, Grubb et al. 1992, Watson 2004). The response of nesting bald eagles to human activity can range from behavioral, such as flushing, or reduced nest attendance, to nest failure (Fraser et al. 1985, McGarigal et al. 1991, Grubb and King 1991, Grubb et al. 1992, Anthony et al. 1995, Steidl and Anthony 1996, Watson and Pierce 1998a). Wintering bald eagles may also be displaced from foraging areas by human activities (Stalmaster and Newman 1978, Stalmaster and Kaiser 1998). The magnitude of response varies inversely with distance, and increases with disturbance duration, the number of vehicles or pedestrians per event, visibility, sound, and position in relation to nest (above, at eye-level, or below the nest) (Grubb and King 1991, Watson 2004). Watson and Pierce (1998a) found that vegetative screening and distance were the two most important factors determining the impact of disturbances. Heavy vegetative screening can dramatically reduce bald eagle response to human activity. Human activities that are distant, of short duration, out of sight, few in number, below the nest, and quiet have the least impact (Grubb and King 1991, Watson 2004).

The effects from disturbance to nesting bald eagles vary, depending on the stage of nesting. In western Washington most bald eagles engage in courtship behavior in January and February, and begin to incubate their eggs by the third week in March. Young hatch by late April, and generally fledge during early to mid-July (Watson and Pierce 1998a). Anderson (1990) found in red-tailed hawks (*Buteo jamaicensis*), as well as in his review of other studies, that adults were more defensive as the parental investment in the young increased (and were therefore less likely to leave the nest unattended or abandon the nest). The natural exposure time from incubation to brooding also naturally increases (Watson and Pierce 1998a), and the bald eaglets began to thermoregulate at the age of 15 days (Bortolotti 1984), indicating that bald eaglets would be less affected by disruption of adult nest attendance as the nesting season progresses.

Contaminants

Contaminants, in particular organochlorine compounds such as DDT, are recognized as one of the primary causes of the decline of bald eagle populations (USDI 1986, 1999). DDT was banned, and registrations cancelled for other toxic persistent chemicals such as dieldrin, heptachlor and chlordane for all but the most restricted uses. The use of polychlorinated biphenyls has also been phased out. The reduction of these chemicals in the environment has resulted in a reduction of these levels of contaminants in bald eagles and a steady increase in bald eagle numbers (Schmitt and Bunck 1995). However, residues of Polychlorinated Biphenyls (PCBs) and Dichloro-diphenylethylene continue to depress productivity in certain locations such as the Channel Islands in California, the Great Lakes and the Lower Columbia River (USDI 1999). Bald eagles continue to be affected by accumulated chemicals such as mercury (USDI 1999), as well as poisoning by lead, organophosphorus and carbamate (Franson et al. 1995).

Foraging

An important component of bald eagle nesting and wintering areas is a consistent source of food. Fish and waterfowl are typically the most important food resource (Stalmaster 1987). Coastal and estuarine areas also provide abundant prey resources, including seabirds and marine invertebrates (Watson et al. 1991, Watson and Pierce 1998b). The availability of food resources is critical during brood rearing, when food limits survival of young (Stalmaster 1987).
Food resources govern the distribution of bald eagles in the winter. In Washington, salmon carcasses, particularly those of chum salmon (*Oncorhynchus keta*), are the most important food source (Watson and Pierce 2001). Because survival of bald eagles in their first year is typically low (Stalmaster 1987), winter food availability is important for survival. Stalmaster and Kaiser (1998) and Hansen and Hodges (1985) have also suggested that winter food shortages or disrupted winter foraging may result in reduced reproductive rates.

Summary

The bald eagle population in the Pacific Recovery Area continues to increase and the majority of recovery objectives have been met. The threats to bald eagles have been reduced, particularly impacts from contaminants and shooting. However, the loss of potential nesting and wintering habitat, and disturbance of bald eagles by humans continues. Threats from these factors have been reduced, but they continue to slow increases in bald eagle populations.

8.0 ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress. Such actions include, but are not limited to, infrastructure (i.e., bridges, roads, recreational facilities) construction, development (i.e., residential, commercial, recreational), and maintenance activities. Past effects of the maintenance and operations of MMD, the Buckley Dam, and the fish trap-and-haul facility are discussed in this section, as they have been part of the environmental baseline since their respective installations, and have had considerable effects on the environmental baseline for bull trout, bull trout critical habitat, and bald eagles in the action area to date. The following paragraphs provide an introduction to the basin and discuss past and present impacts to bull trout, bull trout critical habitat, and bald eagles under separate headings.

The White River basin originates at the terminus of the Winthrop, Fryingpan, and Emmons glaciers on the slopes of Mt. Rainier. The headwaters of the White River are predominantly located within Mount Rainier National Park, Mount Baker-Snoqualmie National Forest, and private commercial timberlands. Flowing from its origin to the confluence with the Puyallup River, the White River is approximately 68 miles long.

As a glacial-fed system, the White River has naturally high levels of turbidity. Turbidity in the White River is measured at MMD and at the U.S. Geological Survey gauge at Buckley. Mean turbidity measurements are 76 nephelometric turbidity units (NTU) at MMD and 86.1 NTU at Buckley, although the values are extremely variable with recorded values ranging from 1 to 1,000 NTU (Table 2). Washington Administrative Code (WAC 173-201A-200) specifies that for Class A waters, “turbidity shall not exceed 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or have more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTU.” Mean turbidity values are 86.1 NTU downstream of MMD. Thus, background turbidity in the White River typically exceeds the 50 NTU constraints.

Table 2. Turbidity Levels (NTUs) observed at the White River Buckley Dam.

Statistic	Value at Downstream Station (USGS #12099100)
Mean	86.1
Standard deviation	173.8
Source: Unpublished 1994–1998 turbidity data collected by the Corps.	

Stream temperatures in the action area vary throughout the year from less than 10 °C to 16 °C. Stream temperatures of the mainstem and/or tributaries that influence the action area are likely related in part to the presence or absence or riparian vegetation along their banks, the glacial or non-glacial origins of tributaries, and other natural and anthropogenic factors. Summer temperatures at the Buckley fish trap are reported by the Corps to range between 13 °C and 16 °C. Daily mean temperatures in the action area are “slightly higher” below MMD compared to above MMD, just downstream of the mouth of the Clearwater River; an average daily temperature difference of 0.89 °C (1.6 °F, for data from 1994 to 1998) is reported for the reach, but temperatures may differ by as much as ± 4 °C. (Corps unpublished data cited on p. 25 in the Biological Assessment for this project). The difference in these temperature readings has been attributed by the Corps in their Biological Assessment to the width of the stream and unshaded conditions downstream of MMD.

8.1 Bull Trout

A number of anthropogenic activities have occurred in the action area throughout its settlement history. Past, present, and future effects of these activities have affected, and will continue to affect, bull trout, their prey, and their habitat in the White and lower Puyallup River watersheds. Genetics studies on migratory char present in the action area (Baker and Moran 2002) indicate these fish are bull trout; although Dolly Varden (*Salvelinus malma*) may exist elsewhere in this system, they are not presumed to enter the action area based on the available data. All individual bull trout in the action area would be expected to be adults, subadults, or older juveniles that have migrated downstream from their natal streams and may be fluvial or anadromous individuals. All known spawning locations for bull trout are well upstream of the action area, in the headwater tributaries to the White River. Consequently, no eggs, alevins, or early-rearing juveniles would be expected to be present in the action area. For the purposes of this Opinion, we will assume the following: 1) most if not all juveniles in the action area would be individuals more than 100 mm but less than approximately 200 mm, and that have left their natal (early-rearing) streams, 2) subadults (approximately 200 to 400 mm) are generally larger than juveniles, and 3) adults are generally 400 mm or greater in size and may or may not spawn each year. All size approximations are estimated based on studies in other systems and are used as a surrogate for assumptions in the absence of applicable White/Puyallup River bull trout life history data. These approximations do not distinguish between fluvial or anadromous life history forms, although it is generally accepted that anadromous bull trout tend to be larger than fluvial bull trout.

Fluvial bull trout may migrate short or long distances within a stream, and it is reasonable to assume that a portion (but probably not all) of the fluvial bull trout individuals present in the White River would migrate downstream of MMD. It is also reasonable to assume that a portion of fluvial individuals originating from the upper Puyallup and Carbon Rivers may enter the action area for foraging, migration, and overwintering. Alternatively, all bull trout exhibiting an anadromous life history phase would be expected to migrate downstream of MMD to the lower Puyallup River estuary. Subadult and adult migratory bull trout in North Puget Sound areas have been observed moving between rivers and marine waters for foraging and overwintering, with variable patterns of migration (Goetz et al. 2004) within and/or between years. It is reasonable to assume that individuals from South Puget Sound streams exhibiting an anadromous life history form would behave in a similar fashion to those found in North Puget Sound streams. The anadromous life history form of char is sometimes thought to occur based on environmental conditions (e.g., when marine resources are more plentiful compared to the forage resources of the stream), and individuals may alternate between anadromous and non-anadromous life strategies throughout their life cycle, remaining in freshwater habitats or becoming anadromous within or between years (Goetz et al. 2004). Consequently, each of the migratory bull trout present in the action area (including those captured in the Buckley fish trap) has the potential to be fluvial, anadromous, or shift between life histories from year to year. They would also be expected to experience a suite of impacts associated with the stream reaches and/or estuaries they encounter during foraging, migration, and overwintering.

Based on observations[5] of bull trout in other systems in Puget Sound, we would expect most fluvial and/or anadromous subadult or juvenile bull trout to migrate downstream from their natal areas at age 1 or older. Bull trout in some Puget Sound watersheds are reported to mature at approximately age 4 (thought to be anadromous fish), although some fish may mature at age 3 or 5. A few relatively small individuals (<300 mm) have been observed in the Buckley fish trap (Ladley, Puyallup Tribe, January 9, 2007; F. Goetz, Corps, personal communication, 2007b), apparently attempting to move upstream, although it is unknown whether these fish were subadults or adults.

The White River basin was historically characterized by large tracts of old-growth forests, fertile river valley soils, and abundant runs of salmon (Kerwin 1999). Throughout its settlement history, however, human activities have had considerable and often compounding effects on species and habitats in the White/Puyallup River Basin. The following paragraphs will summarize the main impacts to bull trout, their prey, and their habitat in the action area of the project as a result of past human activities. While many of these impacts to bull trout, their prey, and their habitat have occurred in the past, others are ongoing and are expected to continue in the future.

8.1.1 Early Flood Control Efforts

As permanent homesteads and settlements began appearing on the landscape in the 1800s, the unpredictable nature of flooding events in the White River created a tremendous obstacle to development within its floodplain. Historically, flows may have shifted intermittently between the Green/Duwamish and Puyallup River basins due to the dynamic and high-energy conditions that were naturally occurring in this system prior to anthropological influences. Early in the 1900s, much of the White River flowed north into the Green and Duwamish River; a small overflow channel, called the Stuck River, flowed south from the vicinity of Auburn into the Puyallup River at Sumner (Kerwin 1999). On November 14, 1906, a rain-on-snow event triggered a flood that created a debris jam in the White River, and directed the entire flow of the White River into the Stuck River. The former White River channel that flowed into the Green River went dry during this event. In response to flooding concerns, King and Pierce Counties formed the Inter-County River Improvement Agency (ICRI) in 1914; one year later, ICRI erected a permanent diversion structure at Auburn, one of many modifications the agency made to the stream for flood control (Salo and Jagielo 1985). As a result of this structure, the White River became a permanent tributary to the Puyallup River. Any bull trout or other migratory fish that may have entered the Duwamish/Lower Green River after this time would no longer have been able to access the White River Basin for foraging, migration, or overwintering in its mainstem or tributaries, or spawn in its headwaters without returning to Puget Sound and

[5] Population estimates of bull trout in the White River are limited. As a result, many of the assumptions made in this Opinion are based on observations of bull trout and other salmonids from other geographical areas.

entering through the Puyallup River Estuary. Alternatively, bull trout or other migratory salmonids entering the Puyallup River Estuary would continue to be able to access the mainstem White River and its tributaries in addition to the Puyallup River and its tributaries, and may have experienced improved access to the White River basin due to the higher flows from the permanently diverted channel.

Other flood control measures have been employed in the floodplain of the White River (Kerwin 1999) by ICRI and other entities. The river is channelized from RM 8.5 to its confluence with the Puyallup River, and flood control structures are present in other areas as well (e.g., private and King County revetments at the White and Greenwater Rivers in the town of Greenwater), with a number of towns, cities, and communities existing at least in part within this reach (e.g., Auburn, Stuck, Pacific, Sumner, North Puyallup, and others). Past channelization and placement of riprap in the stream has likely resulted in reduced foraging opportunities for bull trout and their prey species, as side channel habitats are often decreased or eliminated by channelization effort, as hardening of the shoreline degrades streambank and shoreline habitat for aquatic species. Riverine function has been partially restored in some areas, with certain levees and revetments at the MIT reservation allowed to breach naturally. Bull trout use of these areas is currently unknown, although these areas may enhance foraging opportunities for bull trout or their prey. Efforts to control flooding on a larger scale were implemented in 1939 with the initiation of MMD construction.

8.1.2 Mud Mountain Dam

The general effects of dams and reservoirs have been described in many reports (e.g., Baxter 1977, Ligon et al. 1995, Pringle et al. 2000). Long-term reservoir effects are not applicable to MMD, as the facility does not hold a permanent reservoir. The short-term effects of reservoir creation and filling and long-term effects of the construction and existence of the dam are applicable and have resulted in the following impacts to bull trout and other aquatic organisms: 1) the creation of a migration barrier (although ameliorated in part by the trap-and-haul facility as described below), 2) temporary storage and redistribution and/or removal of sediments and nutrients (including woody debris), 3) alteration of the flow regime, and 4) the periodic disturbance of sediment and vegetation in the reservoir footprint. The effects associated with past operations and maintenance of MMD facilities will be discussed in detail in this section as many are also relevant to the effects analysis of the proposed action, presented later in this Opinion.

8.1.2.1 Upstream Migration

Since its construction, MMD has been a complete barrier to upstream salmonid migration; to mitigate these impacts, the Corps installed a fish trap-and-haul facility at the Buckley Dam in the late 1940s to provide upstream passage for migratory fish. Fish passage above MMD dam is limited to the operations at this facility and the MIT hatchery (which also has a fish ladder) and has been generally conducted year-round at the Corps facility as bull trout and other salmonids enter the trap.

The past operation of the fish trap-and-haul facility has allowed migratory fluvial and anadromous bull trout to pass MMD as they travel upstream to their headwater spawning grounds where it is assumed that they have been able to contribute to the genetic diversity of the White River bull trout populations. The trap-and-haul has also allowed non-spawning fish to access upstream fluvial habitat for foraging, migration, and overwintering. However, like other fish passage facilities associated with dams in the Pacific Northwest, the facility design and operations have also negatively affected individual migratory bull trout throughout its history. Impacts to individual bull trout from past operations of the fish trap-and-haul facility have included migratory delays, stress, injury, and mortality. Observed and reported injury and mortality of bull trout and other salmonids has been low. Consequently, the benefits to local populations and the core area population from overall fish passage around MMD have long been thought to outweigh negative (and sometimes lethal) impacts to a few individuals. The effects from various components of the fish trap design and operation that likely have affected bull trout are described below.

Several features of the trap have impacted adult and subadult bull trout. The elevating floor of the trap is comprised of aged wooden slats (braille), spaced approximately 1 inch apart. The structure of the trap most likely does not allow for small subadult bull trout (individuals with a girth of 1 inch or less) to be captured because of the narrow spacing of the braille on the floor of the trap. Although smaller subadult bull trout have not been observed in the trap during trap operations, other smaller fish species have been observed occasionally. It is reasonable to assume that subadult bull trout (and adult non-spawners) have entered the trap unobserved as they traveled upstream while foraging, migrating, and overwintering in the stream. Subadult fish that were of sufficient size to successfully access the ladder and subsequently enter the trap may have either exited the trap without being captured, were temporarily or permanently trapped in or beneath the braille, or were injured by the crowding of other fish in the trap. As a result of these effects, subadult bull trout that entered the trap would have experienced foraging or migration delays, injury, or mortality.

Migrating fish, including bull trout, may have also experienced delays related to time spent in the trap prior to transport and release, or delays in accessing the trap due to crowding at the fish ladder. During periods of lower returns (approximately October through May), the trap historically has been checked approximately three times per week, and fish have rarely remained in the trap for more than 3 days[6]. Although bull trout retained in the trap during low returns of other salmonids have not necessarily been pre-spawning fish, a migratory delay for any individual is not desirable. Delays of non-spawning fish may result in decreased forage opportunities, as any bull trout that remains in the trap for several days would be unlikely to have access to sufficient forage resources. Delays for pre-spawning bull trout may have affected their spawning condition, especially when stream temperatures were high at or below the trap (up to 16°C during the summer, according the Biological Assessment for this project). The forage needs of bull trout during upstream spawning migrations are unknown, and conclusive evidence

[6] During low returns, the trap is checked approximately three times per week; however, it is possible for fish to remain in the trap for approximately 5 days during this period. For example, if fish are transported on Monday, and Wednesday inspections indicate only a few fish in the trap, the operator may elect to wait until Friday to transport fish. All fish that enter the trap on Monday after the transport could possibly remain in the trap until transport on Friday.

as to whether they forage during this time is unavailable. Like semelparous salmonids, bull trout may be less likely to forage during their upstream spawning migration; alternatively, they may opportunistically forage during spawning migrations or on the spawning grounds to maintain post-spawn condition and survival, unlike other salmonids that spawn only once in their lifecycle. If the latter is correct, a lack of forage resources over an extended time combined with other stressors associated with the trap-and-haul facility may affect their spawning condition or post-spawning survival. The trap has been checked daily during the peak of adult migration, and, in such cases, migratory delays were likely to have been minimal (hours); during non-peak migration, migratory delays (and associated foraging delays) would have been longer (days).

Larger subadult and adult bull trout have also experienced other forms of stress, injury, and mortality in association with the fish trap, although specific records are limited and exact causes of impacts to bull trout and other salmonids are difficult to confirm (Figure 8). Adequate space in the trap holding area exists for most of the year, when fish returns are low. However, during the past few years, overcrowding in the facility has become more of an issue during seasons of high returns, particularly as runs of pink salmon have increased. While the recent increases of Chinook and pink salmon have been favorable for these salmonid populations, and have likely contributed to a greater prey base for bull trout in the system, similar substantial population increases have not been observed for bull trout, although this is likely a result of several factors including, but not limited to, impacts from the fish trap-and-haul facility. The increased crowding of hundreds of salmonids into the fish ladder, holding pool, and trap during the Chinook and pink runs would have resulted in stress, injury, or mortality of bull trout from contact with other fish (e.g., teeth, spines) and trap operations (e.g., multiple lifting and crowding episodes each day). Bull trout in the trap are generally smaller than most of the other salmonid species in the trap (e.g., Chinook, coho, chum) and have probably not been among the first fish removed from the trap when large numbers of larger fish are returning. Consequently, they would have been frequently subjected to multiple lifts of the trap during the peak of their spawning return.

As noted previous, the MIT fish ladder is located at the same river mile as the Corps fish trap, and hatchery and wild Chinook salmon may return to either facility. Most fish access the Corps fish trap due to geomorphological and hydraulic characteristics of the stream in this reach. To meet the management needs for Chinook salmon, all of these individuals have been and will continue to be sorted between hatchery and wild stocks at both locations, with the goal of all hatchery fish (and a few wild Chinook for brood stock) taken to the hatchery, and all wild Chinook salmon and other salmonids (with the exception of hatchery steelhead[7]) passed upstream. During Chinook returns, Chinook salmon and other fish have been routinely dip-netted by non-Corps personnel (typically Tribal technicians) at both traps. Netting activities were reported to occur only during Chinook runs. When Chinook were not accessing the traps, all fish except hatchery steelhead were passed above the dam using the automated hopper, and no hand netting was performed.

Manual capture (i.e., netting) and handling operations that accompany Chinook salmon returns would have also resulted in stress or injury impacts to all fish in the trap, from one or more of the

[7] Hatchery steelhead are not passed above the dam at any time of the year, as there is no steelhead hatchery production in the White River. When captured, they are released downstream of the fish trap(s).

following pathways: 1) increased movement and/or agitation of fish in the trap related to netting actions, and 2) direct contact with nets or other handling. Another possible source of impacts related to the structure of the trap itself has been injury from wear and splintering of the wooden braille. Braille sections in disrepair may have resulted in physical injury to bull trout, particularly when crowded conditions existed. Other fish species have experienced crowding or other injuries (abrasions, open wounds, and jaw injuries) in the trap, with some mortality reported (Ladley, Puyallup Tribe, personal communication, January 5, 2007). While only a few bull trout mortalities have been reported to date (e.g., G. Ging, Service, personal communication, November 14, 2002), close examination of body condition may not have been a priority during large fish returns, when injury to an individual was most likely to occur. It is reasonable to assume bull trout may also have experienced similar lethal, sublethal, or short-term injurious impacts during these operations.

Other handling-related impacts to bull trout in the action area have been associated with the bull trout studies undertaken by the Corps, Puyallup Tribe, and other entities (e.g., Goetz, personal communication, May 22, 2007; Ladley, Puyallup Tribe, personal communication, April 18, 2007). All bull trout handled and tagged in these studies are expected to have experienced stress and short-term injury (at minimum) related to the activities, although most of these effects appear to have been short-term impacts and did not appear to result in mortality, as evidenced by documentation of various movements exhibited by most of the individuals. However, some mortality was associated with the studies. For example, the small number of bull trout tagged by Puyallup fisheries staff in 2005 at the Buckley trap and released back into the Corps facility for transport around MMD all died within 3 months, prompting changes in the release method for the following year.

The Corps has made several modifications to their fish trap-and-haul facility over the past few years to reduce some of the facility's impacts to migratory fish (Dillon, Corps, personal communication, October 30, 2006), although the potential for stress, injury, and other impacts still exists (Ladley, personal communication, January 5, 2007). One modification consisted of reducing the amount of overlap from the steel plate that lifts the hopper gate from 4 inches to 2 inches, to reduce the potential for crushing injuries to heads or bodies of fish that were caught between the plate and the braille during trap operations. Prior to this 2003 modification, injuries to small fish (jack Chinook, pink, and coho salmon) had been observed during high returns (Dillon, Corps, personal communication, October 30, 2006); after modification, such injuries have rarely been observed (Dillon, Corps, personal communication, October 30, 2006), but may still occasionally occur. A second modification to the trap included improved sediment flushing to allow for efficient operation. While sediment buildup may not have caused direct impacts to bull trout prior to this action, lack of sufficient maintenance could have caused the trap to become inoperable, although an actual instance of this occurring as a result of sediment buildup has not been reported.

Delays or injuries at the trap would have increased the effect of the stressors encountered by bull trout and other salmonids during upstream migration. Several factors may influence upstream passage rates, including warm stream temperatures, flows, gradient, and small-scale hydraulic conditions (English et al. 2006, Keefer et al. 2004, Standen et al. 2002, Standen et al. 2004). Summer spawning migrations would have often occurred when water temperatures were high

(13 °C to 16 °C). High stream temperatures in and downstream of the trap would have contributed to the stress levels of the large numbers of migrating salmonids that staged in these areas and would have likely affected their physiological condition when bull trout were exposed to this stressor for long periods (i.e., at a bottleneck below the trap).

Bull trout and other salmonids have been transferred from the trap to a transport truck either by the automated hopper (with water-to-water transfer) or by handing the net containing an individual fish to an operator to be individually released into the truck (during periods of Chinook returns, when fish were netted from the trap). The Corps has equipped two fish transport trucks (a second truck was acquired in 2005) with aerators and a temperature gauge to reduce impacts associated with low dissolved oxygen and elevated temperature levels, respectively. However, the frequency of use of a second vehicle, or what volume of fish triggers the use of a second vehicle is unclear. Impacts to bull trout from transport would have included stress (at minimum) and may have included minor or serious injury if crowding conditions were extreme. Interactions between bull trout and other larger salmonids transported in the aerated truck during crowded conditions have not been documented. Studies of salmonid juveniles and smolts have shown that the physiological effects of handling, transportation, crowding, and/or interspecific aggression stressors on fish vary by species and concentrations of fish (Barton 2000, Barton et al. 1986, Congleton et al. 2000, Maule et al. 1988, Olla et al. 1992), and some studies have indicated greater stress effects from cumulative disturbances and/or short recovery times (Barton 2000, Maule et al. 1988, Olla et al. 1992). The effects from handling, crowding, and transport-related interactions between low numbers of large subadult or adult bull trout transported with high numbers of both larger (e.g., Chinook) or similar-sized (pink) adult fish are unknown, and may differ significantly from effects to juveniles/smolt. However, it is reasonable to assume that, at minimum, bull trout were likely stressed by large numbers of other fish during transport.

Bull trout have likely experienced impacts during release at the release site, although the Corps has endeavored to minimize the impacts of the release point to bull trout by discharging the fish via a wetted metal flume. As water flows from the transport truck's tank through the flume and drops to the stream below, the surface of the water is broken, which enables the fish to contact and enter the water relatively smoothly and avoid injurious, forceful contact with the water surface (Figure 9). The flume, however, is suspended by a permanent frame above the water. The release of pre-spawning bull trout has sometimes coincided with lower summer flows, resulting in larger drop distances (up to 10 ft) from the wetted flume to the water's surface, although at other times, the drop may be less than 4 ft. The Corps has assumed that impacts to the fish from the release have been relatively benign due to the short drop and the breaking of the water's surface as fish were released (Dillon, Corps, personal communication, 2006). However, prespawning fish may have experienced stress (disorientation) affecting their upstream migration abilities, or, particularly in the case of gravid females, experienced stress or injuries that may have affected their spawning success. During an October 31, 2006, site visit (when low returns of salmon were captured and transported from the trap-and-haul facility), Service staff observed adult salmon breaking the surface of the water after release, a behavior that may have been indicative of stress or disorientation (Figure 10). It is reasonable to assume that such stress and/or disorientation has been more severe and perhaps additive during large returns of fish, due to the increased stress and potential for injury from crowded conditions.

Bull trout and other salmonids may have fallen back through MMD after transport throughout past operations of the trap-and-haul facility. Fallback occurs at dams due to a variety of reasons, including, but not limited to, stress from trap-and-haul operations, tagging or other handling, high flows, condition or design of the dam facility, or simply from purposeful downstream movement by an individual related to migration or foraging behaviors (Boggs et al. 2004, English et al. 2006, Keefer et al. 2004, Naughton et al. 2006, Reischel and Bjornn 2003, Schmetterling 2003, Swanberg 1997). Fallback ratios from salmonid studies in other systems (primarily the Columbia and Snake Rivers) have varied, with percentages ranging from <10 percent to 40 percent (Chinook, steelhead, and sockeye) (Gray and Haynes 1977, Naughton et al. 2006). Much of the fallback at other dams may be tied to their designs (e.g., high-velocity spillways, fish confusion in regard to upstream migration routes, etc.) and/or high flows over the spillway, which are different than the design of and conditions at MMD. Some level of fallback has probably occurred at MMD due to 1) high flows through the tunnel(s), 2) disorientation (stress) from handling, transport, and release, or 3) both. Because MMD does not have turbines or release flows over a high vertical spillway, adult bull trout that have fallen back may not have suffered levels of injury similar to the nonlethal, sublethal, or lethal injuries observed at the hydroelectric facilities on the Columbia and Snake River Systems (Schmetterling 2003, Swanberg 1997). However, it is reasonable to assume that, at minimum, migratory delays have occurred as a result of fallback. Additionally, some individuals may not have attempted to re-ascend and would not have contributed genetically to the population during that spawning year.

Observations of bull trout movement and the potential for fallback at MMD are inconclusive. A portion of the bull trout accessing the Buckley trap has been radiotagged and/or floytagged by Puyallup Tribe fisheries staff since the early 1990s (Ladley, Puyallup Tribe, personal communication, April 18, 2007). In 2005, bull trout were fitted with surgical radio tags and were then transported with other salmonids (including large Chinook) captured at the Corps trap and released at the Corps' release flume 4 miles upstream of MMD. Ladley (Puyallup Tribe, personal communication, April 18, 2007) noted that all of the 2005 tagged fish are believed to have died within 3 months (based on recovery of the tags, or lack of movement over a prolonged period), although the exact cause of the mortality could not be determined. In 2006, bull trout were transported by the Tribe separately from the other fish hauled by the Corps after surgical insertion of radiotags and subsequent recovery time (1 to 3 days in a holding tank) and released near the confluence of the Greenwater and White Rivers. This release point is further upstream than the Corps' release flume, and fish did not experience a sizeable drop to the water as with the Corps release flume. In this case, no obvious fallback or mortality was observed. Although there is no definitive evidence as to the cause of the 2005 fallback and/or mortality, it is reasonable to assume that the tagging surgery combined with crowding and/or other handling stress likely impacted these fish. However, the significance of the effects to bull trout from the trap-and-haul is still not clearly understood. These stressors may have also had other unknown and/or undocumented effects to the released individuals. Other studies have shown that, with sufficient recovery time after surgery, such handling would not impair salmonid migration (e.g., Matter and Sandford 2003, Reischel and Bjornn 2003).

Population estimates can also be influenced by fallback. If fallback has occurred at MMD and was followed by one or more re-ascension attempts, fish counts at the Buckley Dam would have been overestimated, an estimation error that has been noted in other studies (Burke and Jepson

2006, Dauble and Mueller 2000, Naughton et al. 2006, Reischel and Bjornn 2003). Inaccuracy in fish counting would be especially significant for bull trout population estimates, due to the very low number (<50) of bull trout observed annually in the trap.

8.1.2.2 Downstream Migration

The ability of MMD to safely pass subadult and adult bull trout throughout the history of the facility is unclear; however, Heg (1953) estimated the presence of approximately 700 juvenile bull trout ("dolly varden") in the diversion flume and main river channel. It is reasonable to assume that all of these bull trout passed downstream through MMD as no bull trout spawning areas are known to be present below MMD. However, the proportion of the total downstream migrants (either subadult or adult) that successfully passed downstream during the study year or any other year is unknown.

Mud Mountain Dam was likely at least a partial barrier to downstream migratory fish passage until the 1990s, when several actions were initiated to reduce impacts to fish and to facilitate safe and effective maintenance operations at MMD. These actions included the removal of the Howell-Bunger valves from the 23-ft tunnel, closure of the bypass between the decommissioned and new 9-ft tunnels, and steel lining of the 9- and 23-ft tunnels. Prior to these modifications, Grette and Salo (1985) described several effects pathways, including 1) downstream migration delay of salmonid smolts, 2) occasional mortality due to turbulence or physical contact with the spillway tower and/or the debris/sediment entrained upon it, and 3) mortality in and/or when exiting from the Howell-Bunger valves on the 23-ft tunnel. It is important to note that the approximately 700 bull trout mentioned in the preceding paragraph had traveled downstream through MMD when these effects pathways still existed, although they may have exited primarily through the 9-ft tunnel at this time. Grette and Salo (1985) indicated that impacts to salmonid smolts would be significantly reduced (but not necessarily eliminated) if the modifications were implemented, based on design changes and similar observations at other facilities (e.g., Howard Hanson Dam, Green River; dams on the Columbia River). They also recommended that the project be reevaluated after construction to assess impacts to downstream migrants under various operating conditions, but to date, no such studies have been implemented. Since the modifications discussed in Grette and Salo's (1985) report were completed, it is reasonable to assume that downstream passage of juveniles/smolts has improved and is less injurious, based on the rationale provided in their report; however, this assumption has not been tested. The authors also did not address the effects of the dam or the modifications on downstream migrating adults (e.g., post-spawner bull trout or steelhead kelts). Further evaluation of downstream passage of juveniles and adults is necessary to test our assumption; however, in the absence of such studies prior to the completion of this Opinion, we will assume that some level of stress, injury, and mortality to subadult and adult bull trout has occurred both prior to and after the modifications to MMD.

Heg (1953) reported a delay in downstream movements of coho ("silver") and Chinook salmon when the reservoir behind MMD was pooled to a head of 185 ft above the tunnel aperature; these fish were apparently unable or unwilling to sound to the depths necessary to pass through the dam. In a further experiment, Heg released juvenile Chinook salmonids both above (at a high pool similar to that described above) and below MMD (above the Buckley Dam), and estimated similar survival rates between the two groups, although the former group experienced a delay. The survival rates were approximately 50 percent[8]; however, the causes of mortality or failure to recapture fish were not described or theorized, nor is it clear whether both groups experienced mortality or escaped recounting as a result of the same factors.

While effects to downstream-migrating salmonids from turbines, screens, and other structures associated with hydroelectric dams have been reported (e.g., Deng et al. 2005, Wunderlich and Dilley 1985, Wunderlich 1988), we were unable to find monitoring data on effects to bull trout or other salmonids from a facility design similar to MMD's existing tunnel design. However, some of the potential impacts to bull trout via downstream passage through MMD can be inferred from other analyses. For example, studies of juvenile and smolt salmonids suggest that these life stages are better able to navigate and adjust to hydraulic changes when they migrate downstream oriented tail first, with their heads facing the direction of flow (Deng et al. 2005, Kemp et al. 2005); when swimming downstream head-first, flows coming from behind can cause damage to scales, opercula, eyes, and gills, depending on velocity of flows, turbulence, and shear stresses. In extreme cases, severe velocities may stress the attachment points of the opercula, resulting in injury to the fish along with increasing its acceleration with the flow (Deng et al. 2005). Kemp et al. (2005) reported behavioral adjustments (including shifts in orientation) of juvenile salmonids as they encountered changing flow velocities, with some individuals even delaying downstream migration. Subadult bull trout migrating downstream through MMD may have experienced similar impacts, particularly during high, turbulent flows.

Passage impacts to adult fish from MMD are even less understood or predictable. Steelhead kelts migrating downstream after spawning have been reported to be indirectly impacted by passage through Snake and Columbia River dams and reservoirs (i.e., high temperatures and low flows), due to their atrophic state after spawning (Wertheimer and Evans 2005). Although adult bull trout migrating downstream through MMD have only a single large dam to navigate (unlike steelhead in the Snake and Columbia Rivers), they may have experienced negative impacts from the dam related to passage, low flows and/or high temperatures, and may have been more susceptible to stress, injury, and/or mortality if they returned downstream soon after spawning. Anecdotal reports suggest that post-spawn bull trout may begin returning downstream from their spawning areas in late October (e.g., Herzog 1993).

Both adult and subadult bull trout in the White River may have experienced physical injury, such as abrasion or contact injury, either in the tunnels or as the fish are discharged into the stream via the 9-ft tunnel (Figure 11) or 23-ft tunnel (Figure 12). In addition to the potential for injury or mortality, subadult and adult bull trout attempting to move downstream through MMD may have experienced migratory delays at higher pools. Some studies have found that fish may experience faster or slower travel times downstream through a dam's reservoir depending on the level of the pool or other characteristics of the reservoir (Aitkin et al. 1996). Although MMD does not maintain a year-round pool, high flow or flood events during spring out-migration may result in variable pool levels behind the dam. The degree to which this may occur at MMD has not been

[8] Heg described the releases of two lots of 2,500 clipped fingerlings, along with the recaptures of 530 and 514 individuals released upstream and downstream of MMD, respectively. It is unclear whether the 2,500 individuals were divided into 2 lots (1,250 each), or whether 2,500 individuals were released in each location. Assuming the former, less than half of the released individuals were recovered in the study.

studied, but it is reasonable to assume that migratory delays may have periodically occurred during high spring and/or flood-related flows where these conditions overlapped with out-migration of bull trout smolts or fluvial juveniles. At Howard Hanson Dam, juvenile salmonids have been reported to show a strong preference for relatively shallow waters (e.g., upper 15 meters of the water column) of a pool, although this may have depended in part on species composition (Dilley 1994). When high pools are present behind dams, salmonid smolts may delay their downstream migration due at least in part to the depth at which they would be required to sound (Dilley and Wunderlich 1993, Maib and Dunston 1956, Regenthal and Rees 1957). Salmonid smolts have been reported to sound to depths of more than 140 ft at Mud Mountain Dam (Maib and Dunston 1956). Regenthal and Rees (1957) reported varying numbers of silver and Chinook smolts sounding to depths of from ≤118 (almost 100 percent of individuals) to ≥160 ft (≤ 8 percent of individuals) at MMD, although they also noted that some amount of delay was experienced by the majority of migrants during varying depth levels. Accordingly, some juvenile bull trout may have experienced migratory delays at MMD when pool levels were high enough to delay, prevent, or discourage them from accessing available downstream passage entrances.

Wertheimer and Evans (2005) suggested that out-migrating steelhead kelts may also prefer surface orientations similar to juveniles. The vertical position and orientation of adult bull trout during downstream migration through MMD is unclear, as is any depth limitation on their ability to access downstream passage entrances at the dam. Adult bull trout have generally been assumed by the Corps to be capable of passing through MMD without significant impacts, although they may have experienced temporary delays at high pool depths. Bull trout (8-15 inches in length) have been reported to sound to at least 140 ft at Swift Reservoir on the Lewis River (J. Hiss, Service, personal communication, April 17, 2007).

Although specific passage data is unavailable at MMD, it is reasonable to assume that adult bull trout that encountered similar pool levels at MMD would not have experienced a significant migratory delay through MMD. When the depth from the surface of the reservoir pool to the top of the tunnels was greater than 140 ft, bull trout may not have chosen to sound to those depths and may have experienced a short-term migratory delay. Post-spawner bull trout in an atrophic state (as described above) would have been more susceptible to the effects of a migratory delay if they were unable to find sufficient forage in the pool or were forced to return upstream.

8.1.2.3 Large Woody Debris Transport

Since its construction, the operation of MMD has interrupted downstream passage of LWD that accumulates behind the dam. LWD that collects on the screens at the intake is stockpiled by the Corps above the facility. Kerwin (1999) reported that approximately 8,000 to 10,000 cords of wood (small and large woody debris) have been removed annually, although the amounts have varied by year (Dillon, Corps, personal communication, October 30, 2006). Since 1997, some of the material has been used in restoration and enhancement projects[9] in western Washington (Dillon, Corps, personal communication, October 30, 2006), although only one project is reported to have been implemented in the White/Puyallup Basin, sited below the Buckley Dam

[9] Allocation of LWD has been on a prioritized scale, with any proposed Corps projects supplied first, followed by allocation to other organizations with projects within or outside of the basin, based on demand.

(Dillon, Corps, personal communication, January 25, 2007). Prior to 1997, any collected wood was salvaged (e.g., for firewood) or, in the absence of further demand, burned (Dillon, Corps, personal communication, October 30, 2006). Small wood deemed unusable for restoration/enhancement projects or for salvage continues to be amassed and burned onsite (Dillon, Corps, personal communication, January 25, 2007).

The removal of LWD from the White River basin at MMD has eliminated an important resource for natural, localized flow regulation, sediment retention, pool formation, and other habitat-forming processes. In particular, deeper pool features can be important for bull trout and other salmonids, providing thermal refugia as bull trout forage or migrate in streams or reaches with warmer temperatures (McIntosh et al. 2000, Service 2004a). Bull trout occurrence has been strongly associated with stream complexity, as evidenced by the presence of LWD, rock, or other stream features (Rich et al. 2003, Rieman and McIntyre 1993). The amount and placement of LWD and the habitat complexity it provides affects the amount of available cover and contributes to the abundance, movement, growth and/or survival of salmonids (May et al. 1997, Rieman and McIntyre 1993, Roni and Quinn 2001) and may offer protection of habitat or individuals during flooding (Harvey et al. 1999, May et al. 1997). The absence of these features is related to the past and ongoing degradation of habitat for bull trout and other aquatic biota in the White and lower Puyallup Rivers.

8.1.2.4 Flows and Sediment Transport

As a flood control structure, past maintenance and operations of MMD have resulted in the direct and indirect manipulation of flows and sediment. The flow regime of the White River has been altered during flooding events or as deemed necessary for maintenance and other activities, with the timing, duration, and amount of high flows modified from natural conditions. Prior to the construction of MMD, flood flows would have likely been higher than existing flood flows, but of shorter duration. The use of ramping rates and other procedures to control flooding of human infrastructure and development have resulted in lower peak flood flows that were extended over a longer time period than the pre-dam peak flood flows. As a result of these activities, the downstream movement of both fine and coarse sediments has occurred at a different frequency and concentration than with natural conditions, as sediments were temporarily stored behind MMD and then released and redistributed downstream as the reservoir levels dropped. Coarser sediments have also periodically accumulated behind the Buckley Dam, passing downstream intermittently (e.g., as wooden flashboards were removed, damaged, or swept away by high flows).

The manipulation of flows and sediment movement has impacted bull trout, their prey species, and habitat in several ways. Bull trout and other aquatic biota that comprise their food web (i.e., aquatic invertebrates and fish) in the White River downstream of MMD have likely been impacted via displacement or have experienced sublethal or lethal effects[10] due to increased duration of flood flows (albeit at a lower peak flood levels), drawdowns, and high levels of suspended sediments, as has been noted in other systems (e.g., Osmundson et al. 2002). The timing of peak and low-flow events within a basin is important to aquatic biota, as many of their

[10] A recent drawdown resulted in stranding and mortality of salmonids, including an unconfirmed report of a bull trout.

life cycles have evolved to avoid or exploit certain peak or low flows (Poff et al. 1997); when flows are regulated, aquatic biota such as macroinvertebrates are often impacted through changes in biodiversity, biomass, and species composition, which in turn may affect their predators (e.g., salmonids) (Hunter 1992). Sustained peak flood flows or low flows, alone or in combination with high temperatures, may also inhibit or modify the timing of upstream migration of prespawning salmonids (Goniea et al. 2006, High et al. 2006, Keefer et al. 2004, Quinn et al. 1997). Flow regulation can also significantly impact riparian vegetation, potentially resulting in scour, sediment/abrasive, and inundation damage (Gurnell 1997, Poff et al. 1997), and the artificially extended duration of peak flows may amplify this effect.

Pooling and associated discharge of the reservoir has also resulted in disturbance of the littoral zone and biota, and nutrient availability both in the littoral zone and within the impounded reservoir. As a reservoir is pooled, changes in the biota (especially algae and invertebrates, the basis of the food chain) occur, with certain lotic species or populations (e.g., Ephemeroptera, Plecoptera, Trichoptera) perishing or being displaced as more lentic-dwelling biota (e.g., plankton, chironomids) multiply (Baxter 1977); the degree and duration of effects to areas immediately upstream and downstream of the dam will vary depending on the frequency or duration of the pool. Throughout most of each year, the manipulations at MMD have been relatively similar to a natural system (i.e., with short periods of flooding, and longer periods of exposed littoral zone due to run-of-the-river flows in the stream), when compared with permanent reservoirs (longer periods of flooded conditions, shorter periods of exposed littoral zone). Additionally, the pooling frequency and duration associated with normal peak flood conditions is reported to have been low, approximately once per year, and lasting about 1 week (Dillon, Corps, personal communication, January 2, 2007); therefore, while the effects described above have occurred each year, their duration is likely to have been short-term, although longer-term effects would be expected in high flood years (e.g., 1996, 2006, 2007).

The manipulation of flows has enabled additional development of areas in and adjacent to the White River floodplain by providing a more predictable flow regime in the White River basin. As mentioned previously, MMD also controls 42 percent of the flows in the Puyallup River; flow manipulation has therefore also enabled development in and adjacent to the lower Puyallup River floodplain. Impacts to bull trout from development in the White and Puyallup River basins will be discussed later in this section.

8.1.3 Power Generation and Associated Infrastructure

In the early 1900s, a diversion dam was constructed on the White River at Buckley by a private entity to facilitate the diversion of water to Lake Tapps. Comprised of wooden flashboards with a wood and concrete substructure, the dam was constructed across the entire width of the White River. A gated diversion flume was placed on the south bank of the White River at the site, and has been historically used to divert water into Lake Tapps for the White River Hydroelectric Project. PSE, the most recent operator of the hydroelectric project, has relied on the existing diversion dam to provide sufficient water elevation behind the dam to direct desired flows into the PSE diversion flume. Since the construction of both the Buckley Dam and MMD, fluvial and anadromous bull trout approaching the Buckley Dam from downstream have had limited to no access to the approximately 5.5 miles of stream between the two facilities for foraging, migration, and overwintering purposes. Bull trout traveling downstream through MMD have been able to use this reach for these purposes.

The hydroelectric project ceased operations in 2004, after PSE determined they would no longer pursue re-licensing of the facility through the Federal Energy Regulatory Commission process but would retain their water right (2000 cfs) for hydroelectric purposes through the WDOE. Federal, State, Tribal, and PSE staff developed an interim operating agreement to ensure that higher flows are maintained in the White River mainstem since the cessation of hydropower operations in 2004 (Table 3). The interim operating agreement also ensures adequate flows (approximately 35 cfs) in the diversion flume for survival of migrating fish that inadvertently enter the flume. However, if ownership of the water rights and/or facilities changes, the interim operating agreement may be terminated.

Table 3. Instream flows in the Mainstem White River as Specified by the Interim Operating Agreement.

Month	Instream Flows (cfs)
November through March	350
April through June	400
July through October	500

The effects to bull trout from past flow manipulations related to this facility were similar to those described above for flood control. While construction and operation of the hydroelectric project occurred in the past, the effects to bull trout from this action, and particularly from those of its associated infrastructure, are expected to continue indefinitely.

Flooding has periodically (1-2 times per year) dislodged the flashboard panels of the Buckley Dam (Figure 13), which results in the lowering of the pool head behind the Buckley Dam (Dillon, Corps, personal communication, February 23, 2007). This impact has affected fish passage operations over weeks or months each year. Since the implementation of the interim operating agreement, the Corps has provided funding for the flashboard repairs (which enables the operation of the fish trap); and together with PSE, has endeavored to coordinate replacement of the displaced flashboards in a timely manner to minimize the potential for dewatering of the trap and the associated impacts to migrating fish; however, such efforts have been subject to flow conditions and precipitation events. Consequently, the flashboards may be absent for a shorter (2-3 months) or longer (7-8 months) period of time, depending on when the repairs have occurred (Dillon, Corps, personal communication, March 15, 2007a).

The trap facility has the potential to partially or fully dewater when attraction flows cease; when this occurs, operations at the fish trap would be suspended for several days (Dillon, Corps, personal communication, February 23, 2007, and March 15, 2007 a, b). To date, the holding pool and the trap/hopper has not completely dewatered, and the Corps has attempted to prioritize flows to the facility during repairs to minimize impacts to bull trout and other salmonids in the trap (Dillon, Corps, personal communication, March 15, 2007b). When operations have been temporarily suspended as prespawning bull trout were migrating in the vicinity of the Buckley

Dam, short migration delays likely occurred; however, it is presumed that the relatively short delay (less than 1 week) would not have precluded spawning for the year. Bull trout present within the fish trap facility (e.g., ladder/weirs, holding pool, trap hopper) and unable to escape when attraction flows ceased, would likely have either 1) experienced a short migratory delay and other stressors associated with the trap (crowding, temperature, and/or dissolved oxygen) until trap operations were resumed, or 2) perished due to predation or other stressors.

Instream impacts have also occurred when sediments are manipulated just above or below the Corps fish trap facility and the Buckley Dam. Heavy equipment has been used in the stream (Figure 14) to excavate a temporary channel for routing flows away from the Buckley Dam sections that were to be replaced (Dillon *in litt.* 2006). Maintenance and repair of this structure has likely resulted in sediment generation and disturbance of benthic habitat.

The Corps and PSE have also temporarily removed panels during spring/early summer (approximately March to July) high flows to preclude failure of the Buckley Dam (Dillon, Corps, personal communication, March 15, 2007b). Panel removal and/or absence has occasionally coincided with timing of early returns of bull trout during their spawning migrations, and is generally conducted with the use of the cable system suspended above the dam (i.e., no heavy equipment is operated in stream) (Dillon, Corps, personal communication, March 15, 2007c). During such operations, the panels adjacent to the fish ladder have been removed to reduce the potential for false attraction flows elsewhere along the length of the dam; significant migratory delays due to false attraction flows were not expected to have occurred (Dillon, Corps, personal communication, March 15, 2007c).

Other impacts to bull trout and other salmonids from the existing dam have likely included 1) physical injury or mortality from the wooden dam apron, protruding metal components, and broken boards, and 2) migratory delays when missing flashboards allow bypass of the fish trap to the upstream reach above the Buckley Dam. Although the effects to bull trout from these impacts have not been documented and are difficult and impracticable to quantify, they are likely significant to bull trout individuals in the action area and the populations of which they are a part.

Since the installation of the Buckley Dam and its associated infrastructure, bull trout and other fish have had access to the diversion flume and, initially, to Lake Tapps. At a minimum, bull trout that entered the diversion flume would have experienced short-term or long-term delays in migration. Other potential effects would have resulted in long-term impacts to the population, including 1) mortality and 2) the failure of individuals to access spawning grounds farther upstream in the system for one or more spawning events. Either of the latter effects would have precluded these individuals' contributions to the genetic potential of the population. In 1996, screens were replaced in the flume upstream of Lake Tapps to reduce impacts to migratory fish from this action and associated infrastructure. Although preliminary results were encouraging, 1996 and 1997 studies of juvenile salmonid survival were inconclusive, and further studies were planned[11] (R2 Resource Consultants, Inc. 1998), but were not completed. Consequently, the effectiveness of the screens and associated impacts to salmonids were never fully tested, and the

[11] However, we are not aware of the existence of any post-study reports or results and assume that the studies were not completed.

performance of the screens at lower flows is unknown. Impacts to juvenile salmonids related to fish screens include stress, injury (including minor fin or scale damage or more serious injury), and mortality (e.g., impingement, predation), depending on screen design and hydraulic conditions (Swanson et al. 2004); similar impacts to juvenile and subadult bull trout accessing the diversion flume may have resulted from contact with the screens. As bull trout have been documented recently in the flume during downstream migrations in the fall (October) (Ladley, Puyallup Tribe, personal communication, October 17, 2006), this will likely continue to be a pathway for impacts to bull trout.

One of the most significant impacts to bull trout from this project was the diversion of flows from the mainstem White River (sometimes referred to as the "bypass reach"). The diversion greatly reduced flows in the mainstem White River, resulting in or contributing to warm stream temperatures, insufficient depth for adult upstream migration, stranding of juvenile and adult bull trout and other salmonids, high levels of eutrophication and pH values from release of effluent from sewage treatment plants, and other effects. Elevated stream temperatures have likely impacted bull trout and other salmonids through physiological stress, migratory delays or timing shifts, and increased susceptibility for disease or mortality (Cairns et al. 2005, Goniea et al. 2006, High et al. 2006, Keefer et al. 2004). Stream temperatures can affect the growth of individuals (although likely to a lesser degree than food acquisition) particularly during the spring and fall. Extreme high temperatures may also affect growth during the summer if forage is inadequate to sustain increased metabolism due to high stream temperatures (Railsback and Rose 1999).

Flow regulation from the diversion or flood control facilities may have impacted drift patterns, colonization, and/or availability of aquatic macroinvertebrates used for forage (Harvey et al. 2006, Osmundson et al. 2002, Poff et al. 1997). Similar effects may have occurred in the larger White River, and may have impacted growth of bull trout and/or their prey species.

Low flows in the mainstem White River, as a result of the diversion, likely stranded bull trout and other salmonids from time to time. While juveniles may be more susceptible to stranding impacts, larger fish may also experience stranding, either above water (e.g., on a bar) or trapped within pools, due to rapid decreases in flows, even if flow decreases do not result in complete or substantial dewatering of a channel (Hunter 1992).

The release of flows through the Dieringer canal downstream of the hydroelectric facility has also impacted bull trout, their prey species, and habitat. High flows from the facility likely served as a false attraction source, which delayed migration of salmonids. Releases also impacted the flows in the lower Puyallup River, and resulted in pronounced daily flow fluctuations which appeared to correspond directly to the releases from Lake Tapps (Sumioka 2004).

8.1.4 Timber Harvest

The headwaters of the White River are predominantly located within Federal lands and private commercial timberlands. Bull trout are known to spawn in the White River system's headwaters above MMD, although the extent of spawning has not been fully investigated. Surveys by the Puyallup Tribe recently documented the occurrence of bull trout spawning activities in eight streams in the upper White River system (Ladley, Puyallup Tribe, personal communication, June 6, 2007). Additional tributary streams and the mainstem White River may support bull trout spawning, although this has not yet been confirmed. The upper White River watershed (that which lies above MMD) has been significantly affected by timber harvest and road building since the 1940s, when intensive logging began in the watershed. These activities have reduced the ability of riparian areas in the watershed to provide LWD and small wood to the system, an integral part of Pacific Northwest habitat-forming processes that provides nutrients and creates and maintains complex habitat. Removal of or disturbance to the riparian vegetation buffer reduces the amount of temperature-reducing riparian shade available to the upper White River and its tributaries. Riparian vegetation provides an important source of terrestrial invertebrate fallout to the stream, used as prey by other aquatic biota. The removal of riparian vegetation also reduces the availability of this resource.

Riparian areas impacted by logging and road construction contribute fine sediments to streams (Ripley et al. 2005); fine sediments can smother eggs and alevins, bury redds, and produce sublethal and/or lethal effects to subadults and adults, depending on the concentration of suspended sediments released. Road systems also change the hydrology of slopes and stream channels and can change the routing of shallow groundwater and surface flow. Even relatively moderate amounts of timber harvest and associated road construction have been shown to significantly impact bull trout populations in other systems (Ripley et al. 2005). Frequent landslides have occurred in the White River basin due to past timber practices. However, changes associated with the 2006 Washington State Forest Practices Habitat Conservation Plan are expected to reduce aquatic impacts associated with some areas of timber harvest in the basin (S. Butts, Service, personal communication, April 30, 2007). In the White River Basin, past road construction associated with timber harvest and other development has also created fish passage barriers that have not yet been reconnected. The effects from these activities have impacted natural salmonid production in the watershed (Kerwin 1999) and are expected to continue into the future.

8.1.5 Development

Urban and rural development in the White River and lower Puyallup River Basins has been substantial over the past century. Development has been enabled and influenced by a number of factors such as the previously discussed flood control activities (e.g., dams, diversions, channelization, and bank armoring), population growth, and the expansion of industry, infrastructure, and residential areas. Since the 1890s, the human population in the White River and lower Puyallup River Basins has increased significantly (Table 4), with populations in some towns and cities increasing by more than 100 percent in a single decade. As populations have increased, impacts to aquatic and terrestrial habitats from the associated industries, infrastructure, and other development also have increased. Decreases in water quantity have corresponded with water quality degradation as stream temperatures increased (due in part to removal or diversion of flows and removal of the riparian buffer in the upper and lower basins) and pollutants have reached the White River and its tributaries from point and non point sources.

Table 4. Estimated population growth in Pierce County and selected cities, 1890 to 2005.

Location	Population Estimate												
	1890	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2005
Pierce County	--	55,515	120,812	144,127	163,842	182,081	275,876	321,590	412,344	485,667	586,203	700,820	755,900
Auburn	--	489	957	3,163	3,906	4,211	6,497	11,933	21,653	26,417	33,650	43,047	47,470
Bonney Lake	--	--	--	--	--	--	275	645	2,700	5,328	7,494	9,687	14,370
Buckley	--	--	--	--	--	--	--	--	3,466	3,143	3,516	7,227	4,515
Enumclaw	--			1,378	2,084	2,627	2,789	3,269	4,703	5,427	7,227	11,116	11,190
Puyallup	--	1,884	4,544	6,323	7,094	7,889	10,010	12,063	14,742	18,251	23,878	33,014	35,830
Sumner	--	531	832	1,499	1,967	2,140	2,816	3,156	4,325	4,936	6,459	8,504	8,940
Tacoma	36,005	37,714	83,743	96,955	106,817	109,408	143,673	147,979	154,407	158,501	176,664	193,556	198,100

Data from Office of Financial Management (http://www.ofm.wa.gov/pop/decseries/historicalpop.xls) and Pierce County (http://www.co.pierce.wa.us/pc/abtus/profile/population.htm) websites.

The following paragraphs will summarize several of the main impacts to bull trout, their prey species and their habitat from urban and rural development in and/or affecting the action area. Impacts from flood control and the PSE hydroelectric facility, although inextricably linked to development in the basin, were described earlier in this section and will not be repeated here.

Urban development in the White and Puyallup Basins has affected bull trout and other aquatic and terrestrial species through changes in terrestrial and aquatic habitats (May et al. 1997). Where development occurs within or adjacent to the floodplain, impacts to the quality and quantity of aquatic systems and habitats are facilitated by the 1) creation of impervious surfaces that both facilitate transport of stormwater and reduce the amount of hyporheic and aquifer/groundwater recharge, and 2) removal and/or disturbance of the riparian vegetation buffer. Urbanization can impact the biological integrity of an aquatic community and may disrupt relationships (e.g., dominance, competition for forage or spawning habitat, etc.) between aquatic species or individuals. May et al. (1997) note that even low levels of development have been shown to impair water quality and aquatic communities in streams.

Over time, additional water allocations to service an expanding population and industry sector have increased the amount of water extracted or diverted from the ground and surface waters of the basin. According to the Draft Puyallup-White Watershed Initial Assessment (WDOE 1995), low flows in the Puyallup River have declined, even with the implementation of instream flows in 1980 and the closure of certain tributaries from additional surface water appropriations. From 1950 through the mid-1990s, the amount of water allocated in the Puyallup River watershed increased four-fold, with additional applications for grounds and surface water pending (WDOE 1995). Kerwin (1999) also notes that surface water withdrawals have been significant in this system and can reduce the amount of rearing habitat for salmonids and result in migration delays. One significant water quantity improvement in the White and Puyallup Rivers has been the recent decrease in the amount of diversion of flows after activities at the hydroelectric facility were discontinued.

A number of factors associated with development affect the water quality in the White and Puyallup River basins. Kerwin (1999) indicated that the water quality in the White River basin was generally good to excellent, although discharges from several sewage treatment facilities have led to increased nutrient and pH levels. Water quality impacts in the White River basin have also been demonstrated by water quality standards exceedances for coliform, pH, instream flow, and temperature in portions of the stream and/or its tributaries. The past reduction of flows in the mainstem White River (due to the Buckley diversion by PSE) and water withdrawals have likely exacerbated the water quality impacts to aquatic biota and habitat. Since the interim operating agreement was implemented, increased flows in the mainstem have likely resulted in at least some dilution of nutrients and other pollutants. However, water quality impacts in the lower White River and the lower Puyallup River are expected to be significant to aquatic biota (including bull trout) and their habitat.

Impacts to water quality may come from impervious surfaces from transportation networks, housing developments (including lawns), businesses, and infrastructure. Transportation systems are an integral part of development and include roads, rail, pipelines, and shipping operations. Impacts related to transportation may occur as a result of the transportation network itself but may also result from facilitated development and infrastructure. Roads transfer excessive inputs of fine sediment into streams, degrading aquatic and riparian habitat, and increase human access, which can result in increased angling mortality and introductions of nonnative fishes, create barriers to fish migration, and increase the potential for water pollution through impervious surfaces and accidental spills (Spence et al. 1996; MBTSG 1998; Ruediger and Ruediger 1999; Trombulak and Frissel 2000, McPhail and Baxter 1996). Dunham and Rieman (1999) found that the density of roads at the landscape level was negatively correlated with bull trout occurrence in some locations. Roads and bridges have degraded shorelines, stream channels, floodplains, and wetlands by altering hydrodynamics and sediment deposition (Trombulak and Frissell 2000). Extensive bank armoring (i.e., to protect transportation corridors) restricts channel migration, degrades or eliminates off-channel habitats, degrades riparian areas, and generally simplifies instream habitat (Trombulak and Frissell 2000, Service 2004a). Impervious surfaces related to road networks have contributed to changes in timing and routing of runoff. Contaminants from automobiles and stormwater runoff have contributed to pollutant loading and degradation of aquatic habitats.

Transportation networks and associated development in the White and Puyallup River watersheds have created significant impacts to bull trout and other salmonids and their habitat in the downstream portion of the action area. State Route 167 in the lower Puyallup River has contributed to constriction of the floodplain and significant development within the floodplain by facilitating access. Historical and more recent transportation and development projects that have been proposed and/or or implemented have contributed to the escalating water quality and quantity impacts associated with increasing stormwater runoff, decreasing of groundwater recharge, and loss of vegetation. The impacts from these past projects will continue into the future. Furthermore, urban and residential development and the creation, expansion (over time), and operation of the marine port in Commencement Bay have significantly reduced habitat complexity and quality in the lower mainstem rivers and associated tributaries and have largely eliminated intact nearshore foraging habitats for anadromous bull trout within Commencement Bay (Service 2004a).

Contaminant inputs associated with wastewater treatment facilities, failing septic tanks, and waste from animal husbandry operations have also impacted water quality in the White and

Puyallup River Basins. Three wastewater treatment plants (Enumclaw, Buckley, and Rainier School) are present in the White River portion of the action area, as are a number of dairies. Wastewater and stormwater treatment facilities, along with the other sources mentioned above, have contributed excess nutrients to the White River, indirectly resulting in increases (and exceedance of State Water Quality Standards) of pH levels (WDOE *in litt.* 2003). WDOE (*in litt.* 2003) reports that a water cleanup plan is being developed by several entities to reduce pH from both point and non-point sources in the White River. Physiological and behavioral impacts to fish can result from either high or low pH levels and range from stress and mortality to impairment of chemical alarm cues or other survival mechanisms (Leduc et al. 2006, Smith et al. 2006, WDOE *in litt.* 2003).

Other contaminants from wastewater and/or stormwater treatment facilities affecting water quality in the White River, lower Puyallup River, and other Western Washington streams likely have likely included polybrominated diphenyl ethers, endocrine disruptors (e.g., estrogens and xenoestrogens from personal care products, chlorinated pesticides, plastics/plasticizers, and other sources), fertilizers, pesticides, petrochemicals, polyaromatic hydrocarbons (PAHs), metals, and other substances, most of which are not removed during the commonly used treatment process(es) (Blanchard *in litt.* 2006, Puget Sound Action Team 2007a). Fish and other aquatic biota and their habitat in the action area may have been and would continue to be affected by these contaminants via alteration of their physiology and/or behavior, and/or bioaccumulation in the food chain. Some of these chemicals and substances, such as PAHs, may be taken up through forage or directly from the water column and/or substrate, and the degree of impact may be dependent on the sensitivity of an individual's life history stage (Meador et al. 2006). Each of the contaminants listed above may result in related negative effects to bull trout and other aquatic species. Impervious surfaces redirect overland flows, reducing the amount of precipitation reaching subsurface areas (Poff et al. 1997). Pollutants may interfere with the ability of bull trout and other salmonids to migrate, avoid predators or other pollutants, or capture prey. When contaminants are combined with other stressors (e.g., high stream temperatures), the results can be compounded.

Pyper et al. (2005) suggest that anadromous species residing in streams for multiple years (e.g., sockeye salmon) before reaching the ocean are more likely to be influenced by local and regional environmental effects in stream habitat than fish that outmigrate as younger juveniles (e.g. pink and chum salmon). They also found that, based on various returns of runs of different species that outmigrated the same year, much of the loss of individuals entering salt water probably occurs during early marine life stages and may be due to a suite of specific environmental conditions. Both fluvial and anadromous migratory bull trout (subadult and adult) would be expected to have been present in the White River and its tributaries (and the Puyallup River) for extended periods of time, for foraging, overwintering, and migration. Consequently, bull trout residing for relatively long periods in the White and Puyallup Rivers have likely been affected by environmental conditions in the streams and, perhaps to a lesser degree, by the environmental conditions in Puget Sound, although these conditions would also have had effects on bull trout. Degraded habitat conditions in the lower White and Puyallup Rivers may have also resulted in a population sink for bull trout or other salmonids, as has been found in other systems with populations of sensitive fish species (Pringle 1997).

A number of recent actions in the action area have undergone consultation, and are expected to continue to degrade aquatic and riparian habitat by reducing recharge, increasing the amount of impervious surface associated contaminants, and facilitating increased development in the basin in and adjacent to the action area, all of which are expected to impact bull trout through the pathways described above. Associated benefits to bull trout, their prey species, and their habitat have also been associated with mitigation activities associated with some of these projects, or even as a direct goal of a construction, enhancement, or restoration action (e.g., White River pipeline replacement project).

8.1.6 Harvest

Harvest of bull trout in Puget Sound streams has been documented since the mid-1800s (Suckley 1861 *in* Goetz et al. 2004), and was specifically noted as occurring in the Duwamish River[12]. According to Suckley's reports, bull trout were observed in streams from June through the end of the year, with larger runs (and associated harvest) beginning in October. Suckley (1874, *in* Goetz et al. 2004) also notes "good fishing" for bull trout near the mouths of the Duwamish and Puyallup Rivers late in the year. While records of bull trout catches in the Puyallup/White River System are not numerous, a later report (Brennan 1938 *in* Salo and Jagielo 1983) indicates 69 "dolly varden"[13] were identified (along with other salmonids and whitefish) in a 1938 check of 158 fishermen at an undisclosed location in the upper White River.

Illegal harvest (i.e., poaching) of bull trout may occur in the White River. To date, the likelihood or presence of poaching in the White or Puyallup River has not been documented (Craig 2001). However, past attitudes toward bull trout have varied throughout its range. Some anglers have considered bull trout a desirable species, as evidenced by the reports in the previous paragraph, anecdotal fishing accounts/guides (e.g., Herzog 1993), or from survey responses (Michael 2004). The bull trout has also been considered an undesirable species and has been historically targeted for removal from streams in either organized or individual efforts by fisheries managers or anglers, respectively (Stuart et al. 1997). One or both of these attitudes may still exist to some degree in the basin; however, the effect to bull trout from any past or present existing illegal harvest in the White River is unknown.

8.1.7 Summary

In summary, bull trout have experienced a number of negative impacts as a result of past human activities in the action area, and the effects of many of these past activities are expected to continue into the future. The aquatic habitat in the White/Puyallup Basin, particularly in the lower reaches, has been channelized and simplified extensively, reducing existing and future off-channel and side-channel habitats for foraging, overwintering, and migrating. These impacts, combined with flow manipulation and interruption of LWD and bedload passage downstream have resulted in increased stream temperatures and the loss of complex habitat-forming processes and thermal refugia for bull trout. Urban and rural development in conjunction with timber harvest activities have increased inputs of pollutants (sediments, contaminants, warmer

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[12] As mentioned previously, the White River flowed into the Duwamish River, then into Puget Sound prior to the construction of the Auburn diversion structure in the early 1900s.
[13] Based on recent genetics studies (Baker and Moran 2002), we assume that these fish were bull trout.

stream temperature) into the aquatic system while also affecting the amount of water available for ecological processes through water withdrawals and increasing amounts of impervious surfaces that reduce groundwater and subsurface recharge.

8.2 Bull Trout Critical Habitat

The action area includes several sections of designated critical habitat: 1) the White River immediately upstream of the Buckley Dam, 2) portions of the lower White River, 3) the lower Puyallup River, from approximately RM 2.5 to RM 8.5, and 4) the nearshore (-10 mean higher high water of Blair Waterway and the nearshore of Hylebos Waterway, including tidally influenced waters in Hylebos Creek.

Seven of the eight PCEs are present within the action area, and the baseline is described below in terms of each applicable PCE. The omitted PCE (PCE #3) is related to spawning habitat for bull trout and is not included in the discussion due to the presumed absence of suitable bull trout spawning habitat in the action area.

PCE #1. Water temperatures that support bull trout use. Bull trout have been documented in streams with temperatures from 32 to 72 ºF (0 to 22 ºC) but are found more frequently in temperatures ranging from 36 to 59 ºF (2 to 15 ºC). These temperature ranges may vary depending on bull trout life-history stage and form, geography, elevation, diurnal and seasonal variation, shade, such as that provided by riparian habitat, and local groundwater influence. Stream reaches with temperatures that preclude bull trout use are specifically excluded from designation.

Water temperatures in the action area vary by season. As discussed previously, stream temperatures in the White River near the Buckley trap range from less than 10 °C to 16 °C, with summer temperatures below the trap from 13 °C to 16 °C. Stream temperatures in the lower Puyallup are similar in range, with measurements available at Station No. 10A070 near the Meridian Street Bridge in Puyallup (WDOE 2006), with a 6-year maximum temperature of 16.5 °C recorded at the station. During July through October 2002 the City of Puyallup measured temperatures near the wastewater treatment plant outfall in the Puyallup River that ranged from 9.0 °C to 15.5 °C (Lange personal communication, 2006.).

Water temperatures measured in Commencement Bay at Brown's Point [UTM 10, 541622E, 5237519N (NAD83)] in 2005 (at a depth of 10 meters) ranged from 8.88 ºC in April to 13.52 ºC in August (WDOE 2007). It is assumed that temperatures in this area are slightly warmer in summer due to freshwater inflow, stormwater runoff, and limited circulation and flushing with Commencement Bay and Puget Sound. The warmer temperatures may sometimes reach levels that discourage extended use by bull trout.

Temperatures recorded in the action area are currently within ranges that support bull trout use, but during some seasons (especially during spawning migrations) are at the high end of the range at which bull trout are found most frequently.

PCE #2. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and in-stream structures.

Channelization has straightened, confined, and simplified the river channel within the lower White and Puyallup Rivers. The channelization and levees have also reduced river processes that form pools, side channels, and other habitat features that add habitat complexity. The lower reaches of the mainstem Puyallup River and portions of the White River also lack the coniferous riparian habitat that was present historically. The lack of riparian habitat and interruption of LWD from MMD has precluded the recruitment of small and large wood from areas most likely to contribute this material (Kerwin 1999).

PCE #4. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variations.

Flood flows in the White River are regulated by MMD for flood control proposes. Consequently, the hydrograph is regulated during part of the year as a result of floods and periodic maintenance (e.g., tunnel repair and maintenance, collection and manipulation of large woody debris, etc.). However, during most of the year the facility operates as a run-of-the-river operation, with a hydrograph similar to natural cycles of flow levels. The effects to critical habitat in the lower White River from flow regulation have been generally limited to the relatively short periods of time that a reservoir is held and released and were likely to be most appreciably expressed through lower peak flows of longer duration than would occur naturally.

The instream minimum flows established at the lower Puyallup River gauge are 1,000 cubic feet per second. For the 14-year time period from 1980 to 1993 inclusive, instream flows were not met at the lower Puyallup River gauge an average of 35 days annually. Generally, these flow violations were in late fall. Low flow averages for the Puyallup River have continually declined even though correlating time periods have had above average precipitation. Increases in impervious surface in the lower Puyallup River sub-basin and reduced floodplain storage has resulted in increased peak flows, quicker peak flows, and reduced base flows (Kerwin 1999). However, since 2004, flow withdrawals at the PSE diversion to Lake Tapps have been reduced with the suspension of activities at their hydropower facility. Diversions prior to this time were substantial and affected flows in both the White River mainstem and the lower Puyallup River.

PCE #5. Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.

The White and lower Puyallup Rivers are assumed to contain springs, seeps, groundwater sources, and/or subsurface flow, all providing cold water to the river. For example, stream temperatures in Clear Creek, a tributary of the lower Puyallup River within the action area, are lower than commonly found in lowland Puget Sound streams and are an indicator of subsurface flow (Pierce County Public Works 2006).

Increased development and groundwater withdrawal through unregulated wells within the lower White and Puyallup River sub-basins have likely lead to a reduction in base flows. Most of the tributaries of the lower Puyallup River also suffer from the effects of development (Kerwin 1999). These changes have likely contributed to loss of cold water sources within the lower White and Puyallup Rivers.

Bull trout utilize the White and lower Puyallup Rivers year-round for foraging, migrating, and overwintering. Juvenile, subadult, and adult bull trout are known to utilize areas of localized groundwater input, such as the mouth of Clear Creek (lower Puyallup River) as refugia from high temperatures in the Puyallup River. Cold water refugia in the foraging, migration, and overwintering habitats of the action area also provides critical "stepping stones" to upstream spawning grounds.

PCE #6. Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.

The White and Puyallup Rivers provide an essential migratory corridor for bull trout (70 FR 56212 [September 26, 2005]) with the exception of MMD and the Buckley facilities. No physical or biological impediments to migratory corridors occur within the aquatic action area. However, summer maximum water temperatures could impede or delay bull trout attempting to move through the action area, which may result in water quality impediments (i.e., stressors) to foraging, migrating, and/or overwintering bull trout.

PCE #7. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

The action area provides FMO habitat for the Puyallup core area. The construction of revetments and levees in the action area and their maintenance and retention has decreased the contribution of prey organisms to the river by reducing the amount of functioning riparian vegetation. The lack of suitably sized gravel may also limit the production of aquatic macroinvertebrates. The action area contains forage fish (e.g. juvenile salmonids) for subadult and adult bull trout. However, limited spawning and rearing habitat for these prey species remains in the lower Puyallup River (Kerwin 1999).

Environmental baseline conditions in the Hylebos and Blair Waterways of Commencement Bay meet few of the biological requirements of forage fish. Intertidal wetlands have been dredged or filled and very little native vegetation or natural plant communities remain. Anthropogenic features such as modified floodplains, hardened banks, and urbanization have eliminated or decreased access to historical bull trout foraging areas. Eight acres of intertidal mudflats remain in Blair Waterway at the mouth of Wapato Creek and Erdahl Ditch (Pacific International Engineering 2001). These mudflats may support bull trout prey. Low numbers of coho, Chinook, and pink salmon have been documented in Blair Waterway. However, warm water temperatures during summer months may preclude bull trout use. A majority of the nearshore within Hylebos Waterway contains limited vegetation supportive of bull trout prey species. Observations have indicated that there is a very small Chinook population within the Hylebos watershed (WDFW 2003). However, an emergent marsh wetland (a restoration site within the intertidal estuary) is located in Hylebos Waterway and provides quality habitat for prey species (GeoEngineers, Inc., 2006).

PCE #8. Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Water quality standards for coliform, pH, instream flow, and temperature have been exceeded in portions of the White River and/or its tributaries. The past reduction of flows in the mainstem White River (due to the Buckley diversion by PSE) and water withdrawals have likely exacerbated the water quality impacts to bull trout critical habitat. Since the interim operating agreement was implemented, increased flows in the mainstem have likely resulted in at least some dilution of nutrients and other pollutants. However, water quality impacts in the lower White River and the lower Puyallup River have likely been significant to bull trout critical habitat, although they have not precluded bull trout use of the stream.

The lower Puyallup River is listed on the Environmental Protection Agency (EPA) 303(d) 1996 approved list for flow and fecal coliform violations (also fecal coliform violations in November 2003 at 270/100 ml and again in September 2005 at 120/100 ml). Additionally, low flow averages for the Puyallup River have continually declined in recent history even though correlating time periods have had above average precipitation, although flows have likely improved since the cessation of activities at the hydroelectric facility at Lake Tapps. Increases in impervious surface in the lower Puyallup sub-basin and reduced floodplain storage have resulted in increased peak flows, quicker peak flows, and reduced base flows (Kerwin 1999).

In Commencement Bay, water quality in the Blair Waterway improved measurably following recent remediation activities (WDOE 1999). Cleanups and source controls are now in place for all known metal sources including log sort yards and a variety of industrial facilities. All metal concentrations are well within State and EPA water quality criteria for marine life (WDOE 1999), but may still be at levels that impact salmonid reproduction, growth, and survival. The Hylebos Waterway is still part of the Commencement Bay/Nearshore Tideflats Superfund site. EPA placed the site on the Superfund List or National Priorities List in 1983. Pesticides, PCBs, PAHs, and metals have been detected in the Waterway at levels that can affect salmonid reproduction, growth, and survival. The Waterway is a 303(d) Category 5 assessed water for tissue samples (Chlorinated Pesticides, DDT, PAHs, and PCBs). Cleanup of contaminated sediments within the 3-mile long Hylebos Waterway is currently being conducted.

Summary

The urban rivers of Puget Sound are impacted from past logging and logging roads in the upper reaches, and agriculture and urban development in the lower floodplains. Intensive channelization to protect urban development and agricultural areas has resulted in the permanent loss of floodplain functions in most of the lower rivers. The loss of riparian vegetation as well as increased discharges of municipal and industrial wastewater and urban stormwater runoff, has resulted in degraded water quality. The WDOE has placed a large number of waterways throughout Puget Sound on the Clean Water Act 303(d) list of impaired waters. In addition to affecting water quality through flow alterations, hydroelectric dams block migration and have isolated bull trout populations in several core areas while water-control structures in the floodplains have effectively eliminated most of the estuaries and wetlands that historically provided rearing and foraging areas. All PCEs within Critical Habitat Unit 28 have likely been degraded, although the severity of degradation varies on a site-specific basis.

8.3 Bald Eagles

The action area is within bald eagle management Zone 4 (Puget Sound) of the Pacific Recovery Area. The main threats in management Zone 4 are considered to be rapidly expanding human growth and recreational use, housing and industrial development, increased human disturbance, overexploitation of fish resources, logging, shooting, harassment, loss of habitat, contaminants in the ecosystem, and lead poisoning (USDI 1986). The Pacific States Bald Eagle Recovery Plan proposed management directions for management Zone 4 include the following: protect nesting, feeding, and roosting areas; enhance prey abundance and availability; discourage human disturbance; and increase law enforcement. In 1998, there were 298 territories in Zone 4 (WDFW unpublished data, 1998), in comparison with a recovery goal of 115 territories (USDI 1986). A more recent data analysis by zone is not available, but the number of territories in Washington has increased since that time (WDFW, *in litt.* 2003).

Bald eagles use the action area for nesting, foraging, and wintering. There are no known communal roosts or wintering concentrations in the action area. However, there is one occupied nest within the action area and is located less than 500 ft from the proposed Buckley Dam project. This pair has successfully produced at least one fledgling each year since 2000, even after the nest was destroyed during a windstorm in December 2003 (Table 5).

Table 5. Bald eagle fledgling counts at the nest located adjacent to the MIT facility at Buckley from 2000-2007 (data courtesy of Richard Johnson, Muckleshoot Indian Tribe).

Year	Fledgling Count
2000	1
2001	2
2002	2
2003	2
2004	2
2005	1
2006	2
2007	2

The general impacts discussed in the preceding paragraphs also apply to bald eagles, particularly via effects to their prey species. Development has altered the landscape for bald eagles, affecting their food sources and habitat quality. However, the pair present in the action area at the Buckley trap has been successful in their attempts to raise young.

9.0 EFFECTS OF THE PROPOSED ACTION

The ESA regulations define "effects of the action" as "the direct and indirect effects of an action on the species or 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 C.F.R. 402.02).

The following sections describe the effects of the proposed action to bull trout, bull trout critical habitat, and bald eagles. Many of the effects were discussed in detail in the Environmental Baseline section of this Opinion, and will be briefly summarized here. Effects to listed species and critical habitat are anticipated as a result of the next 5 years of maintenance and operation activities at the MMD facility, the existing and future Corps fish trap-and-haul facilities, and the replacement Buckley Dam, which will be owned and operated by the Corps upon completion of its construction. We are also considering the effects of the replacement of the Buckley Dam, including both construction impacts and long-term impacts from the existence of the new Buckley Dam. Certain effects from the proposed action are anticipated to continue for the life of the Buckley Dam, and we anticipate that the Corps will also request future consultation on any maintenance and operation of this and the other MMD facilities that would occur beyond this 5-year period.

The extent of adverse effects to listed species, and to bull trout in particular, are difficult to quantify, in part because of the limited data available regarding 1) life history and local/core area population size and composition for bull trout in the White/Puyallup River, and 2) the efficiency and success of upstream and downstream fish passage operations. Consequently, the Corps, the Service, and NMFS have made a number of assumptions concerning these effects based on the limited observations and data available for this basin, bull trout studies and observations in other systems, and studies and observations from other facilities. We have made these assumptions for this 5-year consultation out of necessity, albeit with some degree of risk. However, we anticipate that certain components of the proposed action (i.e., the new Corps fish trap and the new Buckley Dam) will reduce some of the most serious and long-term impacts to bull trout. We acknowledge that future consultation on the long-term maintenance and operation of these facilities beyond this 5-year period will necessitate a greater degree of confidence in our assumptions regarding the effects to bull trout.

9.1 Direct Effects to Bull Trout

The proposed action is expected to directly affect migratory juvenile, subadult, and adult bull trout.[14] Juvenile bull trout in the action area are assumed to be migratory individuals that have left their natal streams and have moved down to the mainstem and/or estuarine portions of the action area. As mentioned previously, fry and/or early rearing juveniles are not expected to be in the vicinity of MMD or the fish trap-and-haul facility, as both facilities are located a considerable distance downstream of bull trout headwater spawning and rearing areas in the White River system.

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[14] Resident bull trout would not be expected in the action area because of their close association to spawning streams in the headwaters of the White and Puyallup River basins.

The effects to bull trout from the activities described below would be expected to be similar for both anadromous and fluvial individuals in the action area, and it should be recognized that each fluvial individual has the potential to become anadromous in the future and vice versa. We therefore assume that any individual in the White River population may become anadromous for a portion of its life history.

The variation of life history strategies employed by bull trout may add benefits (e.g., increased forage and growth opportunities, reduced risk to stochastic events), and risks (e.g., increased exposure to contaminants, degraded habitat, etc.) to individual bull trout as they move within the White River/lower Puyallup River system. Based on the low numbers of migratory bull trout detected annually in the Buckley trap (<50), these benefits and risks are also significant to the White/Puyallup River bull trout populations of which each of these individuals are a part.

The following paragraphs describe the effects of the proposed action on bull trout and are organized in the following categories:

- Mud Mountain Dam Maintenance and Operations
  - Alteration of Flow Regime
  - Sediment-related Impacts
  - Impacts to Bull Trout Migration

- Buckley Dam and Fish Trap Replacement
  - Impacts from Fish Salvage Operations
  - Redirection of Trap-and-haul Operations to MIT Hatchery
  - Sediment and Contaminant Impacts from Construction

9.1.1 Mud Mountain Dam Maintenance and Operation

The continued maintenance and operation of MMD and its appurtenant facilities (including the replacement Buckley Dam and Corps fish trap) is anticipated to adversely affect bull trout via flow regime alteration, suspended sediments, and fish passage impacts to upstream- and downstream-migrating bull trout. Impacts to bull trout from the maintenance and operation of MMD proper are not anticipated to differ over time in comparison to existing maintenance and operations. However, some of the impacts to bull trout from the facilities at Buckley are expected to differ over time (i.e., before, during and/or after construction). For example, impacts from annual repair and maintenance activities to replace missing or damaged wood flashboard panels are expected to occur until the flashboards are no longer exposed to the channel (i.e., during the second phase of construction when isolated by the second cofferdam). Handling impacts from the fish trap activities may increase during transfer of fish trap operations to the Muckleshoot trap facility (e.g., if this transition occurs during increasing returns of fish), but would then be expected to be considerably reduced or eliminated with the completion and operation of the new Corps fish trap. Each of the anticipated categories of direct effects to bull trout are described below; where applicable studies specific to bull trout are lacking, studies of other salmonids are used to provide the best available scientific basis for this Opinion.

9.1.1.1 Alteration of Flow Regime

Flows below MMD vary from pre-project conditions, particularly due to changes in magnitude and duration of peak flows associated with the dam during certain times of the year. The magnitude of flood flows is often decreased during a flood event; however, the duration of the flood conditions and the associated effects to bull trout and other aquatic species, including bull trout prey species, are extended in duration. Since the purpose of the dam is flood control, such peak flow alterations are an unavoidable consequence (and are indeed an objective) of dam operations.

The future application of ramping rates for flood release and attenuation is expected to directly affect bull trout by increasing the likelihood of stranding. While natural peak flows would be expected to be higher than regulated peak flows, the increased duration of peak flows are expected to prolong displacement of bull trout and/or their prey species during flood events. Additionally, stranding of fish may occur during extreme flow reductions or rapid decreases in flows from flow manipulation (Hunter 1992), which would be expected to result in stress or mortality (temperature shock, suffocation, predation, or from temperature stresses, low dissolved oxygen levels, and/or predation). While such strandings are unlikely to be a frequent event, they have occurred in this system and are expected to occur occasionally in the future. However, the frequency of occurrence is difficult to predict. The effects from flow regime changes may negatively affect bull trout and strandings in particular are likely to significantly impair essential behaviors (i.e., result in the injury or mortality) of bull trout as they use the action area below MMD for foraging, migration, and overwintering.

9.1.1.2 Sediment-Related Impacts

The operation and maintenance of MMD results in the periodic accumulation of fine sediments comprised generally of sand and mud behind the dam that are eventually resuspended and released during reservoir drawdown. The amount of fine sediment accumulation behind the dam and the concentration of suspended sediment in released flows depend on the magnitude of the flood event, the duration of reservoir pooling, and the level of flows upon release. If the pooling of the reservoir has been of sufficient duration to allow settling of suspended sediments, sediments may not markedly resuspend until the drawdown is nearing completion (resulting in less turbid water releases from MMD during the earlier releases of flood waters). On the other hand, if additional precipitation events are imminent soon after a storage event, the Corps may choose to release flows at higher rates to provide capacity for additional storage prior to settling; in such a case, the flows may carry a heavy load of suspended sediment throughout the release.

For each flood event or other storage event, operational procedures are adapted where determined feasible by the Corps to manage the diverse effects of reservoir pooling and drawdown. For example, reservoir drawdown is metered to avoid excessive sediment releases. Whenever possible, flushing is scheduled when upstream fish migration and spawning would be least affected, and/or operations are scheduled to occur over several days or weeks to limit the rate of sediment flushing into the river.

Sediments that accumulate behind the dam would include materials that are sloughed from streambanks immediately above MMD when large storage events occur, as well as sediments generated and transported from sources well upstream of MMD and its reservoir. Future operation and maintenance of the MMD facility is expected to alter the concentration of sediments in the water column during and after flood events. Due to the unpredictable nature of flood events and sediment created by runoff from flood events, it is impracticable to quantify the amount of sediment released through MMD during flood events or the direct physical effects from these releases of suspended sediment to bull trout. Nonetheless, sediment effects to bull trout, their prey species, and their habitat are expected to occur. The following paragraphs provide a summary of the potential effects to bull trout from suspended sediment; additional information on sediment effects can be found in Appendix A.

Increased fine sediment delivery resulting in elevated total dissolved solids (TDS) within a river or lake can cause respiratory difficulties for adult and juvenile salmonids at extremely high volumes or for sustained periods. TDS is distinct from turbidity in that TDS represents particulate matter within the waterbody rather than a change in water transparency or color although turbidity is often used as an easily measurable surrogate. If sustained, elevated fine sediment delivery can also cause siltation within the bed of a river where salmon redds are located and can affect adequate upwelling of flow through gravels.

Although no specific data are available for bull trout, increases in suspended sediment are known to affect other salmonids' survival and behavior in several ways, and it is reasonable to assume that similar effects would be experienced by bull trout. Fish may avoid high concentrations of suspended sediments altogether (Hicks et al. 1991). Slight elevations in suspended sediment may reduce feeding efficiency and growth rates of some salmonids. At lower concentrations of suspended sediment, fish may decrease feeding, and, at higher concentrations, they may cease feeding completely (Sigler et al. 1984). In addition, social behavior patterns may be altered by suspended sediment (Berg and Northcote 1985). Not only can feeding efficiency be affected, but high concentrations of suspended sediment can also affect survival, growth, and behavior of stream biota on which salmonids feed (Harvey and Lisle 1998). Suspended sediment may alter food supply by decreasing abundance and availability of aquatic insects as sediments become embedded in the substrate, filling in interstitial spaces where they reside. Suspended sediments may smother invertebrates or larval fishes in the interstitial spaces or may result in emigration of aquatic biota to downstream reaches with less suspended sediments or embeddedness; however, the precise thresholds of fine sediment in suspension or in deposits that result in harmful effects to benthic (bottom-dwelling) invertebrates is difficult to characterize (Chapman and McLeod 1987). The rate of recolonization of impacted stream reaches may last from days to years, depending on site characteristics and the occurrence of flows that flush the sediment further downstream (Anderson et al. 1996). A summary of effects from suspended sediment is listed in Table 6, and a more detailed discussion of effects is included in Appendix A.

Based on the research cited above, we anticipate that the continued release of sediment from MMD will negatively affect bull trout, and will likely result in their avoidance of high concentrations of suspended sediments and potential reductions in feeding, feeding efficiency, and/or growth rates. If these effects are compounded by 1) peak flow changes, and 2) a lack of shoreline/velocity refugia (such as off-channel or side channel habitats), bull trout behavior may be significantly disrupted. Bull trout would generally be expected to move away from areas of increased levels of turbidity. In extreme cases such as gill trauma or physiological stress, bull trout may be significantly impaired, resulting in injury or mortality.

Table 6. Summary of adverse effects to bull trout and other fish resulting from elevated sediment levels.

Sediment Impacts to Fish	Summary of Adverse Effects Related to Sediment Impacts
Gill trauma	Clogs gills which impedes circulation of water over the gills and interferes with respiration
Prey base	Disrupts both habitat for and reproductive success of macroinvertebrates and other salmonids (bull trout prey) that spawn and rear downstream of the construction activities
Feeding efficiency	Reduces visibility and impacts feeding rates and prey selection
Habitat	Fills pools, simplifies and reduces suitable habitat
Physiological	Increases stress, resulting in decreased immunological competence, growth, and reproductive success
Behavioral	Results in avoidance and abandonment of preferred habitat

9.1.1.3 Impacts to Bull Trout Migration

Bull trout are expected to use the action area prior to, during, and after construction of the Buckley Dam for foraging, migration, and overwintering, with the potential for both pre-spawning and non-spawning individuals to access the trap. Marks et al. (2006) reported that bull trout spawning activities occur in the White River watershed during the first 3 weeks in September, although spawning may not be limited to those weeks, based on observations of bull trout entering the trap in September, October, and November. Since 1999 (when bull trout/char began to be consistently enumerated at the Buckley fish trap facility), the largest numbers of bull trout have typically been captured at the trap from June through August[15]. We assume that the majority of the bull trout accessing the trap during this time are likely to be bull trout migrating to their spawning grounds ("prespawners") from the upper White River system. However, it is also possible that a portion of these individuals may be nonspawning adult or subadult individuals attempting to access reaches above the Buckley Dam and/or MMD for foraging purposes. Bull trout may opportunistically forage on the eggs of other spawning salmonids, and it is reasonable to assume that aggregations of salmonids below the trap may be an attractive food source, particularly if some salmonids begin spawning downstream of the facility.

As with studies of bull trout in northern Puget Sound, non-spawning adult or subadult migratory White River bull trout would be expected to be either 1) fluvial, remaining in the mainstem White and Puyallup Rivers (or their tributaries) year round, or 2) anadromous, accessing

[15] This timing represents a substantial shift from observations of Suckley (1861 *in* Goetz et al. 2004), who reported large numbers of bull trout entering the rivers from October through December. The reason for this apparent timing difference is unknown but may be related to a number of natural and/or anthropogenic factors or indicative of bimodal spawning peaks.

Commencement Bay, Puget Sound, and/or the lower sections of other river basins for all or part of the year. It is reasonable to assume that fluvial and anadromous non-spawning (subadult and adult) bull trout may move upstream and/or downstream through the action area throughout the year for foraging, migration, and/or overwintering purposes.

The proportion of non-spawning bull trout present in the action area and/or moving upstream during the peak spawner return is difficult to estimate in the absence of life history information for this core area. Since 1999, when bull trout/char were first consistently enumerated, one or more bull trout have been captured in the trap in every month of the year except January, February, April, and December (Marks et al. 2006). Bull trout returning outside of the window in which pre-spawning bull trout would be expected to access the trap (approximately June through August) may be non-spawner adults or subadults. It is reasonable to assume that non-spawning bull trout may also be present during spawner returns based on preliminary results at the Buckley fish trap, as 13 bull trout less than 400 mm (within the expected range of subadults[16] based on data from other basins) have been documented at the trap in June-August during the past several years (Goetz, personal communication, 2007). Although relative size may be indicative of life history stages or forms, this data would be inconclusive without additional studies, as smaller bull trout captured in the trap may be subadults, non-spawning adults, or smaller prespawner individuals. The extent or level of the effects on bull trout migration may vary with size or life history stage. For example, smaller individuals may be susceptible to injury, mortality, or significant migratory delays when accessing the trap throughout the year, while larger, spawning individuals may be most likely to experience injury, mortality, or significant migratory delays during the periods of highest salmonid returns.

Since 1990, an average of 32 bull trout have returned each year to the Buckley trap (Figure 15), with a low of 15 recorded in 1995 and 1996, and a high of 49 in 2003 according to the weekly Corps fish trap data. During four of those years (1992, 1995, 1996, and 1997), less than 20 bull trout were captured. Since 1997, annual minimum counts have been ≥ 24 bull trout, with more than 35 bull trout recorded annually in all but two of the past 8 years. Bull trout counts recorded by the Corps (and published on their website[17]) and from the Puyallup Tribe (e.g., Marks et al. 2006) have differed somewhat, and the discrepancies have not yet been completely resolved but may be due to counting or transcription error. However, both sources indicate minimum counts of 30 bull trout since 2000. It is possible that some of the returns may be individuals from the Puyallup or Carbon River systems. It is reasonable to assume that most, if not all, of the returning bull trout originated in the White River. Without comprehensive life history studies of Puyallup/White River basin bull trout (which are not available as of the date of this Opinion), we are unable to determine what proportion of bull trout are from the White River system. However, we will assume for the analysis that all returning bull trout are White River bull trout.

We also assume that most bull trout returning to the trap are prespawning adults, although some individuals are also likely to be nonspawning adult or subadult bull trout, based on the relative sizes of the individuals observed in the trap. Goetz (Corps, personal communication, 2007b) estimated that 23 percent (or more) of bull trout tagged by the Corps at the Buckley fish trap were subadults (less than approximately 400 mm), although he noted that the estimate was based

[16] It is possible that some of these subadults may have spawned later in the year as precocious spawners.
[17] http://www.nws.usace.army.mil/PublicMenu/Doc_list.cfm?sitename=MM&pagename=FISHCOUNTS

on size ranges established for bull trout in other rivers, and may not truly reflect the size ranges of bull trout in the White River. We do not expect juveniles (i.e., fish less than 200 mm) to enter the trap based on what is known about their behavior from other river systems (primarily downstream movement) and their assumed inability to access the fish ladder due to its design (Goetz, Corps, personal communication, 2007a). Based on past fish counts at the Buckley trap, it is reasonable to assume that the maximum number of anadromous individuals returning to the trap each year is less than 50 fish, perhaps much less so if a large number of the individuals captured in the trap are fluvial fish. Preliminary data suggest that the anadromous fish may be a small component of the bull trout returns to the Buckley trap, although additional studies (and larger sample sizes) are needed to determine if this is accurate (Goetz, Corps, personal communication, 2007b). Furthermore, we do not expect all White River fluvial fish to migrate below MMD as there is also a great deal of riverine habitat for this life stage above MMD. Consequently, an unknown but likely significant proportion of the fluvial fish would be expected to remain upstream of MMD for foraging, migration, and overwintering.

We are uncertain how many subadult bull trout migrate downstream through MMD to forage in the lower White and/or Puyallup Rivers or the estuary. Heg (1953) estimated the presence of approximately 690 juvenile/subadult “Dolly Varden trout” in the PSE diversion flume and White River downstream of MMD, which we conclude to be bull trout based on more recent genetics studies in the Puyallup River basin and other systems in Puget Sound (Baker and Moran 2002, Goetz et al. 2004). However, no counts of upstream migrating bull trout were available from the Buckley trap during the 1950s, so we are uncertain how many of the juveniles/subadults in his study survived to return upstream to spawn, or if the more recent returns of bull trout (average of 32, but less than 50) were similar in the 1950s.

The following discussion of the effects to fluvial and anadromous subadult and adult bull trout migration through the action area will be divided into two sections corresponding to upstream and downstream migration of subadult and adult bull trout through the action area. The effects to migrating individuals differ depending on the primary direction in which they are traveling. Moreover, impacts will also differ over time, as the replacement of the Buckley Dam and Corps fish trap is expected to reduce some of the existing impacts to bull trout. The downstream migration section will also discuss impacts to out-migrating fluvial and anadromous juvenile bull trout, which would be expected to move downstream through the action area, but would not be expected to return upstream to access the fish ladder until they were subadults or adults.

Upstream Migration

Upstream migration and movement of bull trout is accomplished exclusively through operation of the fish trap-and-haul facilities at Buckley. The effects from the existing maintenance and operation of this facility are expected to change to some degree during and after the replacement of the Corps fish trap. Some sources of impact will be partially or fully ameliorated when the proposed upgrades to the fish trap are installed. Other effects may continue through the life of the project (i.e., and beyond the 5-year period which is covered under this Opinion).

The existence of both the current and replacement Buckley Dams would continue to preclude most bull trout use of the mainstem and tributary instream habitat between MMD and the

Buckley Dam for foraging, migration, and overwintering purposes. Bull trout passage around MMD is essential for the survival and reproduction of migratory bull trout that travel downstream through MMD. However, passage around MMD does not replace the value of the 5.5-mile stretch of instream habitat that will continue to be inaccessible to these individuals for the life of the project. We recognize that viable alternatives to these existing conditions are severely limited, and we do not recommend that access to this habitat be prioritized above fish trap and haul operations.

Fish Trap Operations. Water supply and circulation are generally adequate for fish trap operations under the current design, although the potential exists for the occasional partial or full dewatering of the fish trap when flashboards are missing or removed as previously described in the Environmental Baseline. Dewatering of the facility would likely result in temporary elimination of attraction flows. Given the Corps' daily trap checks during the season in which dewatering of the trap would be most likely to occur, bull trout and other salmonids that access the fish ladder or fish trap would be captured and transported within 24 hours of the loss of attraction water (Dillon, Corps, personal communication, March 15, 2007b). In this instance, impacts to bull trout within or downstream of the fish trap would occur until the flashboards were replaced, approximately 1 to 2 days, as the Corps would first reestablish flow to the fish trap before repairing the flashboards (Dillon, Corps, personal communication, March 15, 2007b). Bull trout in the fish ladder, trap, or downstream of the facility would experience migration delays and physical stressors (crowding, temperature increases, and/or dissolved oxygen reductions) until the Corps was able to resume fish trap operations. Some bull trout within the fish ladder or trap may also experience mortality due to suffocation, temperature stress, and/or avian and mammalian predation, although the short duration of the time spent in the trap (≤ 24 hours) prior to their manual capture and release would minimize exposure of bull trout to these impacts. All of these of effects have the potential to significantly impair essential migration and foraging behaviors of bull trout. However, we would not expect mortality to occur from any sources other than potential predation in or downstream of the trap. After the replacement Buckley Dam is constructed, the fish trap would not be expected to dewater during returns of bull trout. The ladder may be intentionally dewatered during maintenance of the trap, but this would be planned and implemented during winter months, when previous years' data indicate a low likelihood of bull trout returns. Short migratory delays during these months would not delay spawning bull trout or result in prolonged exposure of individuals to warm stream temperatures.

Until the Buckley Dam is replaced, bull trout may experience migratory delays when flashboards are damaged or dislodged due to high flow conditions. Unlike intentional flashboard removal, in which the flashboard(s) closest to the Corps fish trap are removed, flood-related damage or removal could occur at any point along the dam and could result in false attraction flows along the length of the dam. On the October 3, 2006, site visit, adult salmon were observed attempting to swim upstream in the flows passing through damaged or missing panels. It is reasonable to assume that bull trout would exhibit the same behavior and that the existing Buckley Dam would not be a barrier to fish passage when flashboard panels are dislodged or intentionally removed. Consequently, we assume that some individuals will be successful in reaching the area above the Buckley Dam when flashboard panels are missing prior to the replacement of the Buckley Dam. Bull trout that attempted to pass the Buckley Dam at the false attraction flows would experience a significant migratory delay, stress, and/or injury from abrasion or contacting other components (e.g., protruding metal) of the existing dam.

Upon completion of the Buckley replacement dam, bull trout would not be expected to experience significant migratory delays related to trap dewatering, false attraction flows, or injury associated with the structural components of the dam. Coordination with the Service and NMFS on the design and installation of the new facilities is expected to ensure that the new Buckley Dam and Corps fish trap would not result in significant migratory delays, injury, or mortality of bull trout related to these impacts.

Other features of the trap are also expected to continue to impact subadult and adult bull trout, as described previously in the Environmental Baseline section of this Opinion. In-water surveys for small subadult bull trout have not been conducted in the vicinity of the fish trap. However, the White River action area is used by migratory subadult and adult bull trout and it is reasonable to assume that they may be present in this portion of the river after early rearing in headwater streams. Based on the spacing (1-inch) of the braille on the trap floor, small subadult bull trout that attempt to enter the trap may 1) exit the trap without being captured due to the inability of the braille to retain them, 2) be crushed by the raising and lowering of the trap or by larger fish present in the trap, 3) become wedged between the braille slats (as was observed in the mortalities mentioned above), or 4) be temporarily or permanently trapped within the space below the braille. It is reasonable to assume that small subadult bull trout (≤ 1-inch wide) that enter the trap are vulnerable to becoming trapped[18]. At least one bull trout mortality of three observed in 2002 was assumed to be due to such entrainment (G. Ging, Service, personal communication, November 14, 2002). Maintenance operations do not typically include close inspection of the area below the braille, and it is unknown how frequently other trap-related injury and/or mortality may occur. If small subadult bull trout experience lengthy delays related to escaping the confines of the trap, normal foraging behaviors may be significantly disrupted. If the fish are unable to escape the trap, or if significant injury or mortality occurs as a result of the trap, essential behaviors (e.g., foraging) would be significantly impaired, reducing or eliminating the survival of the individual(s), and possibly precluding the contribution of genetic material to the population.

Relatively recent upgrades to the facility (described previously in the Environmental Baseline section) have reduced but not eliminated the potential for negative impacts to fish from the trap due to overcrowding, predation, and protracted inability to forage. Stress, injury, and/or mortality of fish could possibly occur during the initial holding period in the trap, during transfer to the transport truck, and during release back into the river above MMD. The highest numbers of bull trout return to the trap facility at approximately the same time as Chinook salmon returns and are subject to manual capture operations (i.e., netting), unlike more automated facilities that have minimized or eliminated the need for physical handling of fish during routine operations (e.g., Harmon 2003). Record runs of pink salmon during the past few years have resulted in severe overcrowding of the Corps fish trap in late summer, even with multiple trap-and-haul operations per day. Stress, injury, and/or mortality from overcrowded conditions in the trap during and between capture events would be expected to significantly impair essential behaviors

[18] Smaller juveniles are not expected to be able to access the ladder due to its design specifications (Goetz, personal communication, May 22, 2007).

of bull trout, and at worst, would result in the loss of the individual and/or temporary or permanent loss of each affected individual's genetic contribution to the population. As with overcrowding, netting may directly injure or result in increased stress on bull trout, especially due to the associated response (thrashing, lunging) from bull trout and other fish in the trap, which would be expected to significantly impair essential behaviors of some of the bull trout present in the trap. These effects would most likely occur during large returns of salmonids to the trap. After the new Corps fish trap is installed and operating, these impacts are not expected to occur as a result of netting or other similar handling. Bull trout and other salmonids may be guided through the various parts of the trap, but would move via their own volition, with no need to be physically picked up or handled by staff during fish trap and haul operations.[19] Although crowding is expected to occur in the new facility, effects to bull trout are expected to be reduced because 1) bull trout will move through the facility primarily under their own power (although not completely submerged in water while being sorted), and 2) will be held in less crowded pools to await transport.

Fish Transport. Transport operations of fish are expected to be comparable before, during, and after construction of the Buckley Dam, although the location of fish trap loading may change as operations are transferred between the Corps and MIT facilities during construction. Fish typically spend 1.5 to 2 hours in the transport vehicle before being released. Salmonids may be transported in small groups during periods of very low returns, to larger groups (approximately 100+ fish, depending on size) during higher returns. Crowding impacts in the aerated truck tanks would be expected to be most significant during transport of larger groups of fish. Low levels of crowding stress would be expected to significantly disrupt normal behaviors (e.g., migration, foraging) of both pre-spawning and non-spawning bull trout. These effects would likely be short-term, with pre-spawning bull trout recovering quickly to continue their upstream migration with negligible (if any) impacts to spawning success. Non-spawning fish would also be expected to recover quickly under these conditions. High levels of crowding stress in the truck, and/or lethal or sublethal injury would be expected to significantly impair essential behaviors of bull trout, particularly if conditions were compounded by long holding times in or below the fish trap facility during capture activities (due to large returns) and warm stream and air temperatures (e.g., in the summer).

When the new Corps fish trap is completed and begins operating, impacts from the trap are expected to be reduced (as described above), particularly during periods of high return. Consequently, improved pre-transport holding conditions are likely to result in less initial stress during transfer and transport. Additional benefits would likely be realized during periods of high fish returns if bull trout were transported separately from other salmonids, or with a small number of other fish.

Fish Release. Fish release operations are expected to be similar before, during, and after construction of the Buckley Dam, and impacts to bull trout may occur at the release site. However, the Corps has proposed to decrease the height of the drop from the flume to the water to a maximum of 5 ft to reduce impacts to prespawn adults during future operations (J. Laufle, *in litt.* May 9, 2007). Injury and mortality would not be expected to occur under these conditions (B. Nordland, NMFS, personal communication, 2007). While this action alone may not result in

[19] Handling of bull trout by the Corps or other entities may occur during studies covered under separate permits.

significant disruptions of normal behavior or impairment of essential behaviors of bull trout, it is likely an additive stressor for bull trout prior to the replacement of the Corps fish trap. After the replacement of the Corps fish trap, cumulative stress and injury levels are expected to be reduced, with the release unlikely to result in further or additive adverse effects to bull trout.

However, the existing release flume may result in stress or abrasion injuries due to the material of which it is composed, further stressing transported fish. Annual (or more frequent) inspection of the flume and/or its replacement with a flume made of a less abrasive material would reduce the potential for these effects or eliminate them altogether.

Compounded Effects of Trap-and-haul Activities. As described in the preceding paragraphs, bull trout may become stressed and disoriented[20] from any or all of the trap-and-haul activities, and some pre-spawning individuals may experience additional upstream migration delays upon release as a result. Bull trout attempting to migrate upstream to spawn may either 1) recover quickly from any disorientation and complete their spawning attempts in the headwaters of the White River system, 2) remain disoriented and discontinue their attempts to spawn and remain upstream above the dam for an extended period of time, or 3) remain disoriented and fall back over the dam, ultimately failing to spawn or requiring a subsequent transport (which may or may not result in compounded stress, injury, and/or mortality). Furthermore, pre-spawning bull trout that re-ascend one or more times after fallback would be expected to become increasingly stressed at best, and this may influence their fitness or ability to spawn. Prespawning bull trout may be temporarily disoriented upon release, and, in severe cases, normal migration and/or foraging behaviors of some individuals may be significantly disrupted. Others may quickly overcome these effects and successfully access their spawning areas with minimal disruption or delay. If spawning does not occur due to disorientation (i.e., stress) or injury from transport and release of bull trout, significant impairment of essential behaviors of spawning bull trout would be expected to occur. Based on the review of studies on bull trout and other salmonids with limited potential suitable spawning habitat below a dam if fallback occurs (Naughton et al. 2006, Schmetterling 2003, Swanberg 1997), a small percentage of bull trout may fall back through MMD each year. The potential for bull trout to fallback is likely reduced, but not eliminated, due to the distance of the release point upstream of MMD (4 miles) when compared with the respective distances in other bull trout study observations (Schmetterling 2003, Swanberg 1997). It is reasonable to assume that most, if not all, of the significant impacts to bull trout are likely to occur during periods of high fish returns, when 1) large numbers of fish congregate in the trap, 2) the trap is lifted multiple times to capture and transport fish, and/or 3) large numbers of fish are transported to the release site. However, we expect the number of bull trout that would fall back through MMD due to stress or injury (i.e., not simply volitional movement while foraging, migrating, or overwintering) from routine Corps operations to be very low, based on the low numbers of fallback observed in the White River (and the extenuating circumstances for some of these observations). Additional life history studies would be necessary to better understand the frequency of occurrence of this incidence at MMD.

[20] During the October 3, 2006, site visit, observations were made of a number of apparently disoriented and/or stressed adult salmonids (coho and/or Chinook salmon) breaking the surface of the water for several minutes after release from a wetted flume suspended ≥ 10 ft above the water (K. Myers, Service, personal observation, 2006).

Non-spawning bull trout released above MMD may remain above the dam to forage, migrate, or overwinter, or may return to the reaches below MMD under their own volition by migrating back downstream through the dam. If, however, they experience stressful conditions associated with either subsequent trap-and-haul activities, downstream passage through MMD, or both, significant disruption of normal foraging, migration, and/or overwintering behaviors may occur, as described above. Alternatively, increased stress (or injury) may compound the impacts from the initial trap-and-haul activities, resulting instead in significant impairment of essential foraging, migration, and/or overwintering behaviors.

Downstream Migration

Mud Mountain Dam Facility. It is reasonable to assume that some proportion of fluvial migratory bull trout and all anadromous migratory bull trout would attempt to pass through MMD to access downstream reaches of the White and Puyallup Rivers, estuarine areas, and/or Puget Sound. Relatively recent observations and studies have indicated that migratory bull trout individuals are able to pass downstream through MMD. Individual bull trout have been recaptured in the trap-and-haul facility after they have been tagged and released above MMD. Ladley (Puyallup Tribe, personal communication, April 18, 2007) indicated that one bull trout had traveled through MMD at least four times over the past several years.

The timing of downstream migration for bull trout is expected to vary by life stage or by individual. Studies of bull trout in northern Puget Sound (Goetz et al. 2004) indicate that anadromous juvenile bull trout would be expected to migrate from their natal streams in late winter and spring and forage in estuarine or marine habitats during spring and summer, and it is reasonable to assume that juvenile and/or subadult bull trout in the White River system would behave in a similar manner. Observations in the lower Puyallup River and estuary[21] (E. Jeanes, R2 Resource Consultants, personal communication, January 4, 2006), suggest that anadromous bull trout in the Puyallup/White River Basins probably use estuarine and lower Puyallup River reaches in the summer before returning upstream to overwinter, which is consistent with the North Puget Sound studies. Anecdotal observations of postspawner adult bull trout leaving their spawning areas soon after spawning in the headwaters of the White River basin (Herzog 1993), and even passing downstream through MMD as early as October (Ladley, Puyallup Tribe, personal communication, October 17, 2006), have been reported. These data suggest that fluvial and anadromous postspawner bull trout may reenter the action area beginning in the fall (or later) of a given year. Consequently, it is expected that individual subadult or adult bull trout may be moving downstream through the action area at any time of year.

Although bull trout and other salmonids have been known to migrate downstream through MMD, there is limited information on survival rates through the dam or what proportion of the bull trout population or a given life history stage is successful in the attempt (Maib and Dunston 1956, Regenthal and Rees 1957). It is also unknown if bull trout or salmonids are able to survive

[21] Four bull trout that were implanted with radio tags migrated down river to Clear Creek, a tributary to the mainstem Puyallup River; in fact, one of the fish migrated to Brown's Point in July before returning to the lower end of the Puyallup River (approximately 0.5 mile upstream of Commencement Bay) a few days later (Jeanes, personal communication, 2006).

downstream migration at high flows when the 9-ft tunnel is fully inundated and/or the 23-ft tunnel is discharging the reservoir during or between flood events or whether they delay such attempts until flows are lower. If subadult or adult fish (post-spawners or non-spawners) experience significant delays during their migration downstream to access better foraging opportunities, impacts to growth and/or survival may occur.

Further investigation is needed to determine the likelihood of occurrence of these effects; however, no conclusive data at this site were available prior to the completion of this Opinion. The Corps has agreed to begin developing future studies in coordination with the Service, NMFS, and others to evaluate fish passage through the facilities described in this Opinion (J. Laufle, Corps, *in litt.* May 9, 2007). Because this Opinion would cover a 5-year period of maintenance and operations at MMD, we assume that these studies will be implemented well in advance of the end of this period, and, at minimum, preliminary data would be available to test our assumptions on survival through MMD for completing a subsequent maintenance and operation consultation for this facility.

In the interim, however, we assume that subadult and adult bull trout survival downstream through MMD is high, based on 1) the (limited) available information from tracking studies by the Corps and the Puyallup Tribe, and 2) assumptions regarding impacts as a result of the structure of MMD (tunnels instead of turbines, spillways, etc.) and recent modifications to the facility (steel lining of tunnels, removal of the Howell-Bunger valves, etc.). Therefore, we anticipate that few or no subadult or adult individuals would experience sublethal or lethal injuries from migrating downstream through MMD.

We assume that most juvenile bull trout passing downstream through MMD would not experience lethal or sublethal injuries. However, based on the smaller size and migration timing of the juveniles, we would expect that injury or mortality of juveniles may be more likely to occur during periods of extremely high flows when high flows through MMD may preclude safe volitional movement. Additionally, migratory delays during high pools may significantly disrupt normal migration and foraging behaviors of juveniles moving downstream, possibly leading to reduced growth (Maib and Dunstan 1956, Regenthal and Rees 1957). However, such delays would be of relatively short duration (days to a few weeks), and would be highly variable from year to year. The number of bull trout individuals affected by these impacts would be difficult to estimate based on the extremely limited information regarding numbers of downstream-migrating juveniles in this system.

Buckley Facilities. Downstream-moving bull trout (e.g., juveniles, subadults, and nonspawning/post-spawner adults) are not expected to experience significant migratory delays, injury, or mortality associated with the structural components of the dam prior to or during the replacement of the existing Buckley Dam. While a finalized design for the replacement Buckley Dam is not yet available, continued coordination with the Service and NMFS on design features and replacement of the Corps facilities at Buckley is expected to ensure significant migratory delays, injury, or mortality of bull trout related to these impacts would not occur after the replacement of the Buckley Dam.

9.1.2 Buckley Dam and Corps Fish Trap Replacement

The replacement of the Buckley Dam and the Corps fish trap is expected to result in several impacts to bull trout, their prey species, and habitat. Direct impacts to bull trout from the replacement of these facilities would result during construction and from the Buckley Dam's design and presence in the stream, including future maintenance and operation of the structure. Some activities related to either construction or maintenance/operations would result in immediate, corporeal impacts to bull trout, such as capture and removal of fish within the cofferdams prior to dewatering, redirection of fish trap-and-haul operations from the Corps facility to the Muckleshoot facility, or from effects related to features installed during construction. Other activities would impact aquatic habitat, water quality, and/or quantity, such as releases of suspended sediments or diversions of flows. While most of these impacts are expected to result in physical impacts to bull trout present in the action area during construction, some of the effects may also persist further in time.

9.1.2.1 Impacts from Fish Salvage Operations

During cofferdam construction and dewatering of the isolated area, bull trout and other fish stranded within the area to be dewatered will be removed using dip-nets, seines, and/or electrofishing equipment. The use of nets requires multiple people to be in the water in a relatively confined area. Some individuals may be trampled during capture attempts, although this is unlikely to occur due to the large size of the fish expected in the action area. Electrofishing can injure or kill fish (e.g., burned tissue, fractured spinal columns). In addition, both of these methods would cause stress hormones to increase within the fish which could make them more susceptible to predation upon release. Both netting and electrofishing are expected to significantly impair behavior, injure, or kill bull trout. As a precaution, captured fish would be held for a minimum of 30-45 minutes in a dark bucket to improve recovery. The buckets would be drilled with small holes and placed within the stream so the fish would have water with adequate temperature and oxygen. In addition, larger fish would be separated from smaller fish to prevent predation within the recovery buckets, and fish would be released downstream in the White River. These measures are expected to reduce but not eliminate the risk of injury and/or mortality.

9.1.2.2 Redirection of Trap-and-haul Operations to MIT Hatchery

The installation of MIT facility upgrades, in combination with timing of Corps fish trap closures to coincide with periods of low fish returns, are intended to be sufficient to ensure an effective trapping system at the MIT facility during times when the Corps fish trap efficiency is temporarily reduced or is taken out of service. Although upgrade options have not yet been chosen or evaluated, the Corps has committed to several performance standards regarding operation and use of the MIT facility when fish trap operations are temporarily transferred to the facility during construction. Consequently, transference of operations in the interim is expected to result in impacts similar to those described above for the Corps' existing fish trap facility. Therefore, during both low and high returns of fish, normal bull trout foraging, migration, and/or overwintering behaviors are expected to be significantly disrupted, at minimum. During periods of high returns, some bull trout returning to the facility may experience a significant impairment of essential behaviors. However, the long-term benefits to the White River and Puyallup core area populations from the replacement of the Corps fish trap with a less impacting facility are expected to outweigh the short-term impacts to these individuals and populations.

9.1.2.3 Sediment and Contaminant Impacts from Construction

Construction activities at the Buckley Dam and fish trap facility site would be expected to result in short-term impacts to bull trout through an increase in delivery of fine sediment and the potential for contaminants to be released. Sediment could be generated by a number of activities, but particularly as a result of the following:

- Disturbance of uplands for temporary storage
- Operation of equipment around or in the riverbed
- Installation and removal of cofferdams
- Pumping of turbid waters generated within the cofferdams
- Installation and removal of armoring materials along the streambank

These releases would be minimized by onsite sediment control measures as prescribed by existing shoreline guidelines and State regulations. However, some material may still enter the river.

The Service assumes that all construction activities shall comply with water quality standards (RCW 940.48 and WAC 173-201A) set forth by WDOE. These regulations set forth mixing zone standards for the temporary increase in turbidity. The Service expects that at the initial point of sediment disturbance during construction, turbidity levels would be at concentrations that would adversely affect bull trout in the immediate vicinity. Table 6 (above) summarizes the impacts that are expected in this action area.

As the suspended sediment enters the White River and moves downstream, the concentration levels would be diluted and heavier sediments would be deposited. To assess the sediment levels at which adverse effects would occur and determine the downstream extent of sediment impacts for this project, the Service used the analytical framework attached in Appendix A. This framework is largely based upon the findings in Newcombe and Jensen (1996) to evaluate impacts to fish from exposure to suspended sediment.

The guidance in Appendix A requires a measurement of the existing suspended sediment concentration levels in milligrams/liter (mg/L) and duration of time that sediment impacts would occur. The Service used data available on the WDOE website to determine the ratio of turbidity (NTU) to suspended solids (mg/L) (1.35) in the White River during the proposed months of cofferdam construction (July to September). To evaluate the length of time that sediment impacts would occur, the Service estimated that installation of the cofferdams on the right and left banks would each take approximately 10 days to complete, approximately 1 year apart for each bank. Using this measurement and Figure 4 in Appendix A, the Service determined, for this project, adverse effects would occur when the following conditions occur:

For adult and subadults:

1) When background NTU levels are exceeded by 110 NTUs at any time.
2) When background NTU levels are exceeded by 41 NTUs for between 1 and 3 hours.
3) When background NTU levels are exceeded by 15 NTUs for more than 3 hours.

To assess the potential downstream extent of these effects, we relied on the limited monitoring data (from past projects) that was collected to determine compliance with and effectiveness of the Best Management Practices required by the State to address turbidity (see Table 5 in Appendix A). These data provide evidence that water quality standards for turbidity are exceeded in some instances, even with the use of the Best Management Practices. Table 5 in Appendix A reveals that for construction activities involving another cofferdam replacement (activities similar to that proposed for this project), the State water quality standards were not being met at least 200 ft downstream and that the NTUs exceeded the standard by as much as 600 NTUs. Based on this information, the Service anticipates that turbidity levels which result in adverse effects to bull trout are reasonably certain to occur as far downstream as the confluence of the White and Puyallup Rivers. Turbidity levels that would significantly disrupt normal foraging and migrating behaviors of bull trout are expected to be limited to the wetted width of the White River to an area 600 ft downstream during installation and removal of each of the cofferdams, based on the water quality monitoring data and analysis in Appendix A. Impacts are expected to be short-term and temporary in nature, but may result in adverse impact to bull trout as described below.

We expected that adult and subadult bull trout would move out of the area to avoid sediment plumes during construction of cofferdams and other sediment-generating activities, and that bull trout use of the area would be precluded until high sediment levels have subsided. The sediment plumes would significantly disrupt normal foraging and migrating behaviors of adult and subadult bull trout. The exposure of bull trout to excess sediment would occur over approximately 10 days during July through August during the construction and demolition (respectively) of each cofferdam and less than 10 days during any other sediment-generating activity. Bull trout that are in the action area are most likely to be fluvial and/or anadromous adults and subadults, although some juveniles may occasionally enter the action area. The impacts are expected to be short-term and temporary. Although short-term, they may result in some adverse impacts to bull trout as described in Appendix A.

Other contaminants related to construction may also be released as a result of the proposed action. Fuel spills or other contaminants from construction equipment have the potential to enter the stream. Additionally, construction of a seepage wall (if needed) may require the use of uncured concrete. The final design is expected to address prevention of contaminant releases in the stream during construction, and would consist of pH monitoring at and downstream of the project site to minimize effects of concrete contaminants to bull trout and other biota in the White River.

9.2 Direct and Indirect Effects to Bull Trout Critical Habitat

The presence of PCEs within the action area has been documented; however, the exact location and/or features corresponding to some of the individual PCEs (e.g., location of springs, seeps, etc.) are not known. Therefore, impacts to certain PCEs can only be assumed where critical habitat overlaps with the effects of the action. The information below describes direct and indirect effects to each of the applicable PCEs and how the effects will influence the function and conservation role of the Critical Habitat Unit.

PCE #1. Water temperatures that support bull trout use.

Project components such as the removal of riparian vegetation and addition of new impervious surface are known to increase runoff and decrease infiltration to aquatic systems. Reduced infiltration inhibits groundwater recharge and subsurface water exchange and can also result in decreased baseflows. Reductions in baseflow, loss of shade from riparian vegetation, and reduced groundwater recharge and subsurface flows (as cold water sources) can lead to warming of surface waters such as the White River. Also, as water moves downstream through urbanized watersheds heat accumulates unless there are downstream conditions (i.e., such as riparian vegetation) present to allow the accumulated heat to dissipate from the system (Poole and Berman 2001).

However, the extent of the riparian vegetation removal and new impervious surface additions related to the project is small and is not likely to result in measurable runoff or infiltration impacts to the White River watershed. Operations at MMD related to flood control and maintenance may also slightly affect stream temperatures above and below the facility due to periodic pooling of the reservoir. However, the proposed action is not expected to elevate temperatures to a level at which bull trout use is no longer supported.

PCE #2. Complex stream channels with features such as woody debris, side channels, pools, and undercut banks to provide a variety of depths, velocities, and in-stream structures.

The lower White and Puyallup Rivers have been significantly modified from historical conditions by MMD and other flood control structures described previously, and by development in and adjacent to the floodplains and the Puyallup River estuary. Consequently, stream channel complexity is relatively low. Although MMD does not interrupt downstream movement of wood that is small enough to pass through its tunnels, the proposed action would continue to interrupt the passage of much of the larger wood at MMD, precluding further in-stream structure recruitment of this material and the habitat-forming processes that larger pieces would provide in this system. Although the reintroduction of LWD passage below MMD would likely restore at least partial function of this degraded PCE, the Corps has no plans to facilitate such passage at this time. Any LWD that enters the White River from sources downstream of MMD that is intercepted at the Buckley Dam would be allowed to pass downstream, as is all small woody debris. This PCE currently exists in the action area in a degraded condition. The proposed operations and maintenance of MMD and its appurtenant facilities would maintain this PCE in its present condition.

PCE #4. A natural hydrograph, including peak, high, low, and base flows within historic ranges or, if regulated, currently operate under a biological opinion that addresses bull trout, or a hydrograph that demonstrates the ability to support bull trout populations by minimizing daily and day-to-day fluctuations and minimizing departures from the natural cycle of flow levels corresponding with seasonal variation.

Although stream flows in the White and Puyallup Rivers are regulated by maintenance and operation of MMD, the hydrograph demonstrates the ability to support bull trout populations in the action area. Run-of-the-river operations throughout most of the year minimize daily and day-to-day fluctuations and departures from the natural cycle of flows, except during peak flood events or during maintenance activities. These exceptions occur over a relatively short time-period and do not appear to eliminate the ability of the White River to support bull trout populations, as evidenced by the relatively low but consistent returns of bull trout to the Buckley fish trap in recent history (i.e., since bull trout have been consistently identified and enumerated).

PCE #5. Springs, seeps, groundwater sources, and subsurface water to contribute to water quality and quantity as a cold water source.

Constant temperatures above 16°C are intolerable for bull trout (Poole and Berman 2001) but bull trout will migrate through higher temperatures by utilizing areas of thermal refuge, such as a confluence with a cold water tributary, deep pools, or locations with surface and groundwater exchanges, many of which may be created or supported by springs, seeps, or other subsurface cold water sources. During the summer, temperatures in the lower White and Puyallup Rivers are at the high end of the range in which bull trout are most frequently found. Given the degraded nature of the baseline in the action area, existing cold water sources provide critical "stepping stones" to upstream habitat. As these "stepping stones" are degraded and/or eliminated, the ability of the river to support migratory bull trout is reduced.

The proposed action is not expected to impact existing springs, seeps, groundwater sources and/or other subsurface water sources that would contribute to water quality or quantity. Consequently, this PCE is expected to be maintained in its current condition.

PCE #6. Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.

The proposed action is not expected to result in any long-term biological or water quality impediments to the migratory corridor. Some localized, short-term water quality impacts to the migratory corridor may result from construction, but these are not expected to preclude upstream migration of bull trout. Although the existing MMD facility is a complete physical barrier to upstream fish passage, the associated fish-trap facilities were constructed and have been operated to mitigate the impacts of this barrier. Current fish passage operations are sufficient to pass many if not all of the salmonids that enter the trap, but the facility is undersized and results in adverse impacts to bull trout and other fish that enter the trap, due to stress, injury, and sometimes mortality from the trap-and-haul operations or other stressors related to the facility (e.g., predation in or below the trap). The proposed action would improve this PCE by providing a new, upgraded trap facility with sorting capabilities that is expected to improve survival and reduce stress for bull trout and other salmonids over present and historical conditions. Consequently, post-construction effects from this portion of the proposed action are expected to reduce, but not completely eliminate, adverse effects to the migratory corridor.

MMD is not a physical barrier to downstream migration, as it contains tunnels for the passage of water, fish, small wood, and substrate. However, it is unknown whether all fish that travel downstream through the tunnels do so without experiencing adverse impacts. Conditions have likely improved since 1996, when the injurious Howell-Bunger valves were removed and other modifications were made to the facility. The facility also likely results in periodic but relatively short migration delays when the reservoir is held at a high pool, which may discourage some individuals or group of bull trout (e.g., especially out-migrating juveniles) from sounding to the tunnel entrance(s). However, it is assumed that most of the fish that migrate downstream through MMD do not experience appreciable stress, injury, or mortality.

The existing Buckley Dam impedes upstream fish migration, and may cause migration delays, injury, and/or mortality when the panels are damaged, dislodged, or removed. The proposed action would replace the dam with a new concrete-and-steel structure that would reduce the potential for these adverse effects. Bull trout and other salmonids would no longer bypass the fish trap and access the reaches between the two dams during their upstream migration, and hence would no longer experience a delay due to such a volitional bypass. The new dam would be designed and constructed to avoid injury or mortality to bull trout from its operation and maintenance, but some migratory delays due to the fish trap may still occur. Overall, impacts to the migratory corridor from the Buckley Dam are expected to be reduced as a result of the proposed action.

PCE #7. An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Prey species of bull trout (especially salmonids) are expected to experience project-related adverse effects similar to those described previously in the Effects of the Action section. However, many of the returning salmon species (Chinook, coho, and chum) would be larger and would not be expected to respond or be as vulnerable to some of the effects as smaller-sized fish (e.g., bull trout and pink salmon). Numbers of some salmonid returns (e.g., Chinook, pink, and coho) have increased during recent years (Figure 16) due at least in part to management practices and/or the removal of in-stream impediments to migration. These increasing numbers of fish are likely to contribute appreciably to the food base for bull trout via their eggs and juveniles. The installation of a more effective barrier dam to increase the effectiveness of the new Corps fish trap is expected to further improve passage and abundance of these species. Consequently, the proposed action is expected to be beneficial to all of the salmonid populations over the long-term and would improve this PCE.

PCE #8. Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

Although a number of water quality impacts have been documented in the action area, bull trout continue to use the lower White and Puyallup Rivers and the lower Puyallup River estuary for foraging, migration, and overwintering. Several individual bull trout have been captured more than once in the trap, with one bull trout captured four times over the past several years (Ladley, Puyallup Tribe, personal communication, April 18, 2007). These observations, although based on a very small sample size, suggest that future maintenance and operation of the dams and fish trap would not further degrade this PCE.

In summary, direct adverse effects to bull trout critical habitat are expected as a result of the proposed action. However, the following points should be noted when considering the impact of these effects to bull trout critical habitat:

- Although several PCEs will continue to be degraded, the proposed action is not expected to result in the loss of any PCE.

- Sustained interruption of LWD at MMD will continue to degrade PCE #2 (complex stream channels). However, some LWD is still available for recruitment in the reaches below MMD, and the Buckley Dam will pass all wood that becomes entrained on the structure. The proposed action would not alter the existing condition of the PCE in the action area to an extent that the conservation value of critical habitat in the Puget Sound Unit for the bull trout would be appreciably reduced.

- Water quality impacts associated with construction-related sediment are expected to be localized and short-term and will not preclude use of designated critical habitat throughout the action area by bull trout.

- Water quantity and temperature-related impacts associated with the operation and maintenance of MMD are expected to be periodic and short-term and will not preclude use of designated critical habitat in the action area by bull trout.

9.3 Direct Effects to Bald Eagles

Direct effects of the proposed action to bald eagles will be discussed in two separate sections below. The first section will describe direct effects to bald eagles from routine maintenance and operations of MMD, not including replacement of the Buckley Dam, and will be followed by a discussion of direct impacts to bald eagles from replacement of the Buckley Dam. Although the replacement of the Buckley Dam is related to maintenance and operation of MMD, it is a discrete activity that will not reoccur and will be discussed in a separate section.

9.3.1 Maintenance and Operation of Mud Mountain Dam

Currently, there are no bald eagle nests within 1 mile of MMD (at RM 30) or its reservoir. Any appreciable disturbance to nesting or wintering bald eagles from activities at MMD would likely be attributable to flow manipulation of MMD in the downstream portion of the action area, but is not expected to result in stress, injury, or mortality to bald eagles. Therefore, no direct effects to bald eagles from the routine maintenance and operation at MMD are expected. A bald eagle nest is located adjacent to the MIT facility at Buckley and is in line of sight of the Buckley project site. The eagles using this nest and the riverine habitat within the action area would not be directly affected by the routine maintenance and operation activities of MMD, although they may experience indirect effects through their prey species (discussed later in the Indirect Effects section).

Maintenance and operation of the existing and proposed facilities at Buckley are not expected to result in direct adverse affects to bald eagles based on previous anecdotal observations of eagle behavior at this site. A pair of bald eagles has used the nest near the MIT facility consistently for the past several years, after having constructed this nest when their previous nest in the immediate area was destroyed during a storm. The MIT and Corps facilities provide forage opportunities for the bald eagles, as exemplified by recent observations by MIT hatchery staff during release of juvenile hatchery fish (R. Johnson, personal communication, June 11, 2007). Routine operations at the Buckley facilities including, but not limited to, annual maintenance of the Buckley Dam has not resulted in displacement of the eagles from the nest or failure of the nest. While the addition of the proposed new maintenance deck may allow for greater access of MIT and Corps staff and vehicles between the two facilities, the level of activity at the site is not expected to result in appreciable disturbance of the bald eagle pair at the site.

9.3.2 Buckley Dam Replacement

No bald eagle nesting or roosting habitat would be altered or removed in association with the replacement of the Buckley Dam and Corps fish trap or with the upgrades to the MIT facility. Potential foraging would be less than optimum within the project area during construction. Elevated sound levels and human activity during construction represent a potential short-term impact to nesting bald eagles.

Although bald eagle impacts would most likely come from disruptions in nesting behavior and/or success during the months of January through August, this bald eagle pair is acclimated to high amounts of human activity within the immediate area. Several sources of human- and construction-related disturbances are familiar to the resident bald eagles including traffic on Highway 410, the MIT hatchery operations, PSE flume operations, and fish trap operations. It is likely the pair is accustomed to human disturbance and would continue to nest and raise young in the presence of the construction project.

Measures that would be implemented to minimize disturbance would be to limit construction between the nesting period of January 1 and August 15 to the extent practicable. Avoidance of all potentially disturbing construction activities within the work windows would be impracticable due to the long period of time required for construction and potential impacts to fish migration and human elements of safety. Daily construction periods can be designed to minimize disruption within the nesting period and may be limited to daylight hours. Still, increased sound and disturbance that would accompany construction of the new Buckley Dam would warrant monitoring of the existing bald eagle nest for disruption. Qualified wildlife biologists would be onsite or available to observe bald eagle behavior and ensure disruption of the nesting bald eagles is avoided or minimized. However, it is possible that construction of the Buckley Dam and Corps fish trap and MIT facility ugrades may significantly disrupt normal foraging and breeding behaviors of bald eagles. If bald eagles are appreciably disturbed or displaced to the degree that they abandon their nest, eggs, nestlings, or juveniles, or if juveniles fledge prematurely, essential foraging or breeding behaviors may be significantly impaired.

9.4 Indirect Effects to Bull Trout

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur (50 CFR. 402.02). Indirect effects may occur outside the area directly affected by the action. The following paragraphs will describe the indirect effects to bull trout, including effects from the 1) maintenance and operation activities at MMD, the Corps fish trap, and the new Buckley Dam, and 2) construction of the new Corps fish trap and replacement Buckley Dam. Indirect effects from the proposed action will continue to incrementally degrade bull trout habitat and prey resources in the future. The impacts described below will contribute stressors and adversely affect individual bull trout and the local and core area populations of which they are a part, making them more vulnerable to the direct impacts described above.

9.4.1 Large Woody Debris

Future maintenance and operations of MMD will continue to interrupt LWD passage and availability downstream of the facility. The presence of LWD and its potential for recruitment within the inundation zone and downstream of MMD is well below historic levels; consequently, the substantial habitat benefits LWD would provide, if allowed to pass MMD, would continue to be lacking in this system. Woody debris provides nutrient input to aquatic systems, and LWD can also provide temporary sinks for sediment, create pools and other complex habitat features, which can provide physical and thermal refugia for bull trout and other aquatic biota in addition to localized bank stabilization and flood control (Gurnell 1997, McIntosh et al. 2000). The reduction in LWD passage contributed to simplified aquatic habitat downstream of MMD. Both LWD and small woody debris that reaches the Buckley Dam is currently passed through or over the dam and would continue to be passed at the site. However, this woody debris is limited to 1) the woody debris that is small enough to be passed through MMD, and 2) the LWD and small woody debris that enters the White River between MMD and the Buckley Dam.

The proposed action would provide for LWD accumulation and stockpiling above MMD, particularly at the high flows most likely to mobilize LWD of a size that is preferred for enhancement projects and other uses. However, LWD movement through or around MMD is not anticipated or planned under the proposed maintenance and operation plan of the facility, although the Corps periodically makes the stored LWD available to other entities for enhancement purposes. Consequently, the ability of LWD recruited upstream of MMD to shape the development of instream habitat, such as maintaining spawning habitat for prey species, cover from predation, and pool forming functions, would be severely limited. Under the proposed maintenance and operation plan for MMD, some small woody debris would pass through MMD or become mobilized into the channel downstream of the facility, but at sizes and quantities much less than would be present in the absence of MMD, or if all accumulated wood was passed around MMD. The proposed action would continue to reduce levels of LWD in the White and Puyallup Rivers downstream of MMD and would result in continued degradation of downstream foraging, migrating, and overwintering habitat for bull trout. Habitat for prey species of bull trout, such as salmonids and other forage fish, would also continue to be degraded. These impacts are expected to significantly disrupt normal bull trout foraging, migrating, and overwintering behaviors.

9.4.2 Flow and Sediment Alterations

The future application of MMD's ramping rates for flood release and attenuation is expected to affect bull trout via continued impacts to habitat and the food web. The increased duration of peak flows are expected to prolong the effects of displacement of benthic invertebrates and fish that are prey species of bull trout due to flood events. These organisms are important contributors to the food web that supports bull trout growth and survival.

Releases of increased concentrations of suspended sediments during reservoir drawdown is also expected to impact bull trout prey species in similar ways and may result in additional effects to redds, eggs, and alevins of other salmonids that spawn below the dam, all of which would be potential forage resources for bull trout. Suspended sediments may also impact habitat and other parts of the food web.

Adequate spawning gravels exist for some species above and below the proposed action, and Chinook and other species may use the area in the vicinity of the Buckley Dam for spawning purposes. No records of bull trout spawning below or directly above the Buckley Dam currently exist. It would be difficult to determine if bull trout were spawning below the Buckley Dam because of natural turbidity in the White River, but spawning is not expected due to the absence of sufficiently cold stream temperatures in this reach. During construction of the project and subsequent operations, the potential for scour of spawning habitat for bull trout prey species exists downstream of the Buckley Dam. Downstream scour would be caused by hydraulic conditions created by water traveling through and/or over the new Buckley Dam, although the downstream apron is being designed to reduce the potential for scour. As high flows pass over the new Buckley Dam, localized scour may occur immediately downstream of the dam. However, because of the localized nature of this scour, we do not expect bull trout prey species that may spawn below the dam to be appreciably affected.

Based on the expected low numbers of bull trout in this system, a slight decrease in prey in these localized segments of the action area is not expected to appreciably affect bull trout. Therefore, while habitat degradation is expected to continue as a result of impacts from altered flows and suspended sediments, the associated effects to bull trout via their prey species are expected to be relatively minor.

9.4.3 Levee Expansion

The expansion of the existing levee along the northern shoreline adjacent to the MIT facility at Buckley would impact aquatic and riparian habitat for bull trout by increasing the extent of existing shoreline armoring and removing riparian vegetation currently growing on the levee. These impacts are expected to further degrade habitat conditions for bull trout habitat and their prey species between MMD and the Buckley Dam, and may impact the geomorphology of the stream and associated habitat upstream and downstream of the levee within these bounds. However, these impacts are not expected to occur downstream beyond the Buckley Dam or upstream beyond the White River canyon and MMD, as these structures and/or features would arrest changes in stream geomorphology from levee expansion. Based on the expected low numbers of bull trout in this system, a slight decrease in prey in this localized segment of the action area is not expected to appreciably affect bull trout. Therefore, while habitat degradation is expected to continue as a result of impacts from levee expansion, the associated effects to bull trout via their prey species are expected to be relatively minor.

9.4.4 Diversion of Flows

The Corps has no jurisdiction over direct operation and maintenance of the diversion flume or its gates which connect to the White River just upstream of the fish trap facility. However, future diversion of water through the gated flume in its current configuration would be dependent on the presence of a barrier dam similar in function and placement to the existing and proposed replacement structure that results in varying levels of pooling of water upstream of the dam. (The operation of the fish trap is also contingent on this pool created by the Buckley Dam.) Significant upgrades or modifications to PSE's gates that control the diversion are not part of the proposed action and remain the responsibility of PSE or any future owners of the diversion flume and gates. Minimum instream flows downstream of the Buckley Dam are also ultimately determined in part by the diverting entity through positioning of the gates. The new Buckley Dam will have operational capability to control flows through the dam, but the gate settings would be primarily for sediment passage, adult attraction to the fish trap, and subadult passage.

The diversion of flows is currently regulated by the interim operating agreement described in the Environmental Baseline of this Opinion. The duration of this agreement is uncertain and may be ended upon completion of the replacement dam at Buckley, or with the sale or transfer of property from PSE to other entities. Because additional permitting procedures are pending and/or would occur at a later time, the amount of future flows in the mainstem White and Puyallup River cannot be determined at this time. PSE recently petitioned WDOE to modify its existing permit to expand the beneficial uses of its water right claim to include maintenance of water levels at Lake Tapps for recreation, water quality, and other purposes. The existing water right claim imposes no restrictions on diversions as to minimum instream flows, nor does the application propose any minimum instream flows for the White River. A Report of Examination has been drafted by WDOE and was submitted for public comment (WDOE *in litt.* 2006), but a decision has not yet been finalized. Consequently, the extent of future operation and management of the diversion flume and other facilities still currently owned by PSE is uncertain at this time and depends on numerous factors. The magnitude of future effects to bull trout and their habitat from the diversion of flows may vary, and are expected to primarily include impacts related to water quality and quantity (i.e., increased temperature). Additionally, bull trout would continue to have volitional access to the diversion flume through its unscreened entrance just above the Buckley Dam and fish trap. Bull trout that enter the flume would be potentially stressed, injured, or killed by seasonal high stream temperatures and/or predation.

For the purposes of this Opinion, we assume that the instream flows in the White River will be at least equal to those specified in the interim operating agreement. During the time period covered by this consultation, it is possible that the instream flow requirements from WDOE's Report of Examination (Tables 6) may be implemented. However, these flow requirements are not anticipated to be lower than the flows specified in the interim operating agreement. If instream flow requirements are reduced from the interim operating agreement's instream flows, the effects of the proposed action to bull trout may have greater significance to bull trout populations in the White and Puyallup River due to the added stressors of elevated stream temperatures and contaminant inputs to streams that would result from insufficient instream flows to support foraging, migration and overwintering.

Table 7. White River Minimum Instream Flow requirements from the WDOE Report of Examination (from WDOE *in litt.* 2006).

Month	Minimum Flow in cfs at the Buckley Gage (USGS 12099100)
January	350
February	350
March	350
April	400
May	400
June	400
July	500
August	500
September	500
October	500
November	385/350
December	350

9.4.5 Repairs to the Existing Buckley Dam

Future repairs to the existing PSE dam at Buckley are expected to impact bull trout, and the extent of impacts would depend on the amount of damage to the facility and the potential for the operations of the fish trap to be temporarily interrupted, as discussed previously. For example, damage to the Buckley Dam from storms in November 2006 and January/February 2007 has resulted in several dislodged flashboards that have compromised the effectiveness of the structure as a barrier to upstream fish passage. The Corps and PSE were unable to complete repairs to the existing Buckley Dam during early spring and early summer due to flow conditions and to avoid impacts to out-migrating juveniles. Planned repair work in late summer 2007 may result in significant delays during the bull trout spawning migration. Some individuals may access the trap upon first reaching the vicinity of the fish trap, or may return as to the trap after a short delay upstream of the trap, as evidenced by the 26 bull trout (as of June 26, 2007) recorded at the Corps fish trap since the start of 2007 (Ladley, Puyallup Tribe, personal communication, June 26, 2007).

Alternatively, prespawner bull trout may continue to access the reaches upstream of the Buckley Dam until the flashboards are replaced, and may or may not return downstream to the Corps fish trap. Those that return to the fish trap would be captured and released above MMD, but would likely experience a significant migratory delay, which would significantly disrupt normal migration and spawning behaviors of these individuals. If these individuals remain in the 5-mile reach between the Buckley Dam and MMD, and did not return downstream to the Corps or MIT fish traps, they would be unable to access their spawning streams. These individuals would either elect not to spawn, or would spawn in unsuitable habitat, precluding their genetic contribution to the White River populations for the year. Consequently, their essential migration and spawning behaviors would be significantly impaired for the spawning year. Injury or mortality may also occur if bull trout came into contact with components of the existing structure (e.g., wooden dam apron, protruding metal components, and broken boards). However, all of the effects described in this section would no longer be expected to occur after the Buckley Dam is replaced.

Annual repairs to the existing Buckley Dam until it is replaced would result in similar effects to those described in the Environmental Baseline section. Effects may range from migratory delays, such as those described above, to suspended sediment levels or the potential for contaminant releases from the operation of heavy equipment in or near the stream. We anticipate that the effects from these activities would result in significant disruption of normal foraging and migration behaviors of bull trout.

9.5 Indirect Effects to Bald Eagles

Indirect effects to nesting bald eagles from the Buckley Dam replacement may occur due to increased traffic at the maintenance deck. The bald eagle pair using the nest adjacent to the project has successfully fledged young during the past several years with the current level of human activity. Prior to the construction of the maintenance deck, traffic is not expected to exceed recent ambient disturbance levels. During implementation of the project, however, some of the vegetation between the nest and the MIT hatchery may be removed to facilitate construction of the maintenance deck and its approaches, reducing the partial visual barrier provided by the trees. After construction, the maintenance deck is expected to improve access between the Corps fish trap facility and the MIT hatchery, likely resulting in increased human presence in the form of increased vehicular and pedestrian traffic between the facilities. Based on current designs for the maintenance deck, the deck would be a single span across the White River. Additionally, Corps and MIT hatchery staff would no longer be limited to the existing road access outside of the immediate area to access the opposite bank.

Both increased vehicular and pedestrian traffic is expected to result in increased disturbance to nesting bald eagles, and this disturbance would be expected to intensify during nesting and fledging activities in early summer, when Chinook returns necessitate additional staff and activities at the Corps fish trap. Visual and sound disturbance during the nesting season is expected to result in temporary or permanent abandonment of nest or young. Based on their past history, if this bald eagle pair permanently abandons the nest, they would be expected to construct another nest in the territory.

10.0 INTERRELATED AND INTERDEPENDENT ACTIONS

Interrelated and interdependent actions are actions that would not occur but for the proposed action under consultation. An interrelated action is an action that is part of the proposed action and depends on the proposed action for its justification. An interdependent action is an action that has no independent utility apart from the proposed action. No interrelated or interdependent actions are expected to occur as a result of the proposed action.

11.0 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

In general, cumulative effects from activities and land uses within and affecting the action area range from rural and agricultural activities to dense urban development throughout the basin. Most permitted activities in the action area that involve in-water work (e.g., bridge construction, additional flood control) would have a Federal nexus and would be reviewed under separate section 7 consultations. However, a number of projects that are 1) under the scope of local jurisdictions or 2) that are undertaken without a permit are expected to occur in the foreseeable future (Service 2007). These include increased development, transportation projects (see Appendix B), expansion of the Port of Tacoma, and other projects.

One of the most significant cumulative effects to bull trout and aquatic habitat in action area is the result of continued residential, urban, and industrial development. Over the last 10 years, the Puget Sound lowlands including the lower portion of the action area adjacent to the lower Puyallup River have displayed a pattern of rapid urban expansion, and the relatively short distance from the White River watershed to the major urban centers of Seattle and Tacoma is also expected to encourage increased development in the upper portion of the action area. Like most western Washington cities, the cities and communities within the White River Basin (e.g., Auburn, Buckley, and Enumclaw) are expected to continue to grow. The Puget Sound Regional Council predicts that between 1998 and 2030 there would be a 37 percent increase in population in the lower White River Watershed (excluding Tacoma), from 210,000 residents in 1998 to 330,000 in 2030 (PSRC 2001). Similarly, population growth in Pierce County is expected to increase by 34 percent by 2025 (Puget Sound Action Team 2007a). Several assumptions can be made about this growth in western Washington: 1) that growth of residential development is likely to be high around the peripheries of the existing population centers, and 2) that developed areas in western Washington are expected to expand east toward the Cascade foothills (WSOFM 2001).

While many of these cities and communities are outside of or adjacent to the action area, their activities directly and indirectly affect the quality of habitat for bull trout and other aquatic species (including bull trout prey species) within the action area. Additionally, development pressures will also likely result in a loss of vegetation and forest cover and an increase in impervious surfaces. Reduction in forest cover and conversion to impervious surfaces can change the hydrological regime of a basin by altering the duration and frequency of runoff, and by decreasing evapotranspiration and groundwater infiltration (May et al. 1997, Booth et al. 2001). Conversion of privately-held timberlands to residential use is a resource concern in this basin, as it is throughout much of Washington State.

The growing human population in the action area is expected to impact bull trout in the action area through increases in chemical contamination, habitat degradation, elevated stream temperatures, and flow changes as a result of the replacement of pervious surfaces with impervious surfaces, an increasing reliance on flood control, and further conversion of forested lands to more developed areas. The predicted population increase in the surrounding cities of 20 percent between 1998 and 2030 (PSRC 2001) would likely cause increased effluent discharges into White River from all of the sewage treatment facilities in the White River basin, two of which do not have a Federal nexus. Additionally, there would also be an increasing demand for water usage related to consumption, recreation, and other purposes both from the communities surrounding Lake Tapps and from other cities and development in the basin. These water withdrawals would exacerbate water quality impacts related to elevated temperatures, flow alterations, and contaminants, all of which would adversely affect bull trout, their habitat, and their prey species.

Several examples of such impacts currently exist in the action area. Operations and maintenance of the facilities currently owned by PSE are likely contingent on future restrictions or regulations on 1) seasonal timing and volume of water diversion, and 2) actions that would potentially be necessary downstream of the Buckley Dam as mitigation for the impacts of flow diversion. In the Lower Puyallup River basin, continued urbanization is expected to further degrade the aquatic ecosystems in the mainstem of the lower Puyallup River and its tributaries and adversely affect bull trout. It is anticipated that, in these and other systems, Critical Areas Ordinances as well as planning and development consistent with the Growth Management Act and the Shoreline Management Act may reduce the potential magnitude of some but not all of these impacts to listed species, their prey, and their habitats. However, impacts are still expected to be significant.

Future climatic conditions are also expected to affect the White and Puyallup River basins. Climate-related effects can be divided into two broad categories. The North Pacific environment is governed in part by decadal or multi-decadal cycles with changes in atmospheric pressure and wind patterns that affect ocean currents and water temperatures (Anderson 2000). The cycles (commonly expressed as El Niño/La Niña years) are relatively short-term. Ocean conditions created by these cycles affect numbers and distributions of fish and other oceanic species. For example, during years when the climate regime in the Pacific Northwest is warm and dry, ocean conditions for some of the Columbia River salmon appear to be poor, while Alaska salmon experience good conditions. When the climate regime is dominated by cool and wet years, the opposite is true, with the Columbia River salmon generally experiencing better conditions than Alaska salmon (Anderson 2000). The success or failure of management (e.g., of fisheries), restoration, enhancement, and other actions has not always been considered in context with climate cycles, and the cycles may mask success or failure if they are not carefully evaluated (Anderson 2000).

Recent observations and modeling for Pacific Northwest aquatic habitats suggest that bull trout and other salmonid populations will be negatively affected affected by ongoing and future climate change. Rieman and McIntyre (1993) listed several studies which predicted substantial declines of salmonid stocks in some regions related to long-term climate change. More recently, Battin et al. (2007) modeled impacts to salmon in the Snohomish River Basin related to predictions of climate change. They suggest that long-term climate impacts on hydrology would be greatest in the highest-elevation basins, although site-specific landscape characteristics would determine the magnitude and timing of effects. Streams which acquire much of their flows from snowmelt and rain-on-snow events may be particularly vulnerable to the effects of climate change (Battin et al. 2007). In the Pacific Northwest region, warming air temperatures are predicted to result in receding glaciers, which in time would be expected to seasonally impact turbidity levels, timing of flows, stream temperatures, and species responses to shifting seasonal patterns. Ball (2004) suggested that climate change would alter the hydrology of the White River basin, with higher stream flows in the winter, earlier runoff in the spring, and lower flows in the summer. He also noted that both instream flows and flows available for diversion to Lake Tapps during the summer are likely to be less reliable in the future.

Battin et al. (2007) suggest that salmonid populations in streams affected by climate change may have better spawning success rates for individuals that spawn in lower-elevation sites, especially where restoration efforts result in improved habitat. Higher elevation spawners would be more vulnerable to the impacts of increased peak flows on egg survival. They further note that juvenile salmonids spending less time in freshwater streams before out-migrating to the ocean would be less impacted by the higher temperatures and low flows than juveniles that rear longer in the streams. Bull trout generally spawn in cold headwater streams, and juveniles may spend 1 to 3 years rearing before moving downstream to large river reaches or estuarine/marine habitats. Therefore, bull trout would be less likely to adjust their spawning areas downstream based on their spawning habitat needs related to water temperature. Connectivity between lower and higher reaches of the White and lower Puyallup Rivers and Puget Sound may become even more critical for the growth and survival of fluvial and anadromous individuals that access this area for foraging, migrating, and overwintering purposes.

If the current climate change models and predictions for Pacific Northwest aquatic habitats are relatively accurate, bull trout would be adversely affected through one or more of the following pathways:

- Disturbance or displacement of eggs, alevins, juveniles, and adults of resident and/or migratory adults during winter flooding events
- Short-term or long-term changes in habitat and prey species due to stochastic events during winter floods
- Changes in flow/out-migration timing in the Spring for bull trout and their prey species
- Increased migration stressors from low stream flows and high stream temperatures during spawning migrations

12.0 INTEGRATION AND SYNTHESIS

12.1 Bull Trout

In the Environmental Baseline, Status of the Species, and Status of Bull Trout Critical Habitat sections of the Opinion, we established that past, present, and future effects of flood control, development, and other activities in the White/Puyallup River Basins have and will continue to adversely affect bull trout. The action area, which is used by several local bull trout populations in the White and Puyallup Rivers, is essential to migratory individuals that travel downstream of Mud Mountain Dam to forage, overwinter, or migrate between habitats. As noted previously, bull trout in the Puyallup core area are at an intermediate risk of extirpation from habitat isolation and fragmentation.

Past, present, and future impacts to bull trout from the activities described in the Environmental Baseline and Cumulative Effects section, when combined with the effects from the proposed action, are significant. The effects of these activities on the likelihood of survival and recovery of bull trout must be considered in light of short-term and long-term climate cycles and trends, which may either temper or exacerbate the overall effects to bull trout and the aquatic and terrestrial systems on which they depend. A number of mitigation, enhancement, and restoration projects have been planned and/or implemented in the core area, and these projects may provide important benefits to bull trout, other biota, and aquatic/terrestrial habitats. For example, projects may provide localized or largescale benefits to aquatic biota and their habitats through fish passage improvements (e.g., culvert replacement or removal), increases in floodplain function (e.g., levee setbacks), and localized reduction of adverse effects through a few low impact development projects. However, it is unlikely that the benefits these and other projects provide will be sufficient to mitigate the full extent of impacts to bull trout, their prey species, and their habitat caused by past, present, and future development and potential climate change trends in this core area.

The Service expects the proposed action would adversely affect bull trout, their prey species, and their habitat via several pathways. The continued alteration of the flow regime and the interruption of LWD at MMD are expected to continue to incrementally degrade habitat in the action area, maintaining low stream channel complexity and high summer stream temperatures that negatively influence migration and spawning success of bull trout and other salmonids. The existence and future operation of MMD is also expected to maintain the relatively predictable flood flow conditions downstream that would support and encourage further development in and adjacent to the lower White and Puyallup Rivers as the human populations in these area expand. Past and present development supported by MMD and other basin flood control projects throughout history have made the continued and future presence and operation of MMD obligatory to maintain the existing and future homes, businesses, and infrastructure associated with the cities, towns, and transportation networks in their present configurations. Future development is expected to further degrade aquatic and riparian habitat through additional stormwater and wastewater releases and their associated contaminants. Increasing allocations and extractions of surface and subsurface water is expected to exacerbate the contaminant contributions of these stormwater and wastewater releases and contribute to higher stream temperatures. As more land in and adjacent to the floodplain is developed, there will be an intensifying dependence on flood control to protect human infrastructure, reinforcing this cycle and its associated impacts to bull trout foraging, survival, migration, and thus indirectly to spawning success.

Adverse effects to bull trout from the proposed action are also expected in the form of significant stress, injury, and mortality during holding in the trap or during upstream and downstream fish passage operations. We expect the magnitude and severity of injury would be relatively low for bull trout individuals migrating downstream based on our assumptions regarding the design, operation, and maintenance of these facilities. To improve upstream passage, and to significantly reduce impacts to bull trout (particularly during periods of high returns of salmonids), the Corps has proposed to 1) replace their functional but antiquated fish trap with a new upgraded facility with sorting capabilities, and 2) replace the existing flashboard dam with a permanent structure that would reduce the potential for migratory delay, injury, and mortality of bull trout. This replacement and the corresponding improvements in operation of the facility are expected to greatly reduce impacts to upstream-migrating bull trout.

Short-term, construction-related impacts (e.g., suspended sediment, migratory delays) may have significant impacts on individual bull trout. However, mortality is not expected to occur as a direct result of construction activities, although mortality and other impacts may occur related to operations at the Corps fish trap facilities. Mortality and other impacts may also occur at the MIT facility when fish passage operations are temporarily transferred to the right-bank facility during construction. Adverse effects from maintenance and operation of the facilities at Buckley (dam & fish trap) are expected to be reduced upon completion of construction. We recognize that there may be 1) a loss of individuals, and/or 2) a migratory delay or other stressor that precludes spawning (for one season) prior to or during construction. The loss of genetic contribution from these migratory bull trout each year for up to 5 years could be significant to the long-term survival of the core area's local bull trout populations by temporarily reducing the resilience of the population. However, we expect that the timely installation and subsequent use of the new Corps fish trap and the reduction of adverse impacts from the replacement of the existing Buckley Dam would enable the population(s) to rebound from any such loss. This expectation is based on an analysis of bull trout return data collected at the fish trap since 1990, when low annual returns of <20 individuals were recorded in 1992, 1995, 1996, and 1997 (see Figure 15). These low numbers are followed by a moderate increase in bull trout returns. While the total returns are still low, the counts indicate that bull trout returns at the trap have the potential to increase when previous years' counts are low. After construction, improved conditions at both the Buckley Dam and Corps fish trap should result in decreased severity of impacts to bull trout during fish passage operations, and better survival rates and improved spawning condition for bull trout individuals over the long-term.

The ability of bull trout populations to persist is supported by their connectivity to other populations and habitat condition and structure, which allows risk from stochastic, deterministic, and/or genetic causes to be spread out across local populations and their habitats (Rieman and McIntyre 1993). Local populations that are relatively proximal to each other can provide a source for recruitment after stochastic events with short-term impacts to habitat, such as the 2006-2007 flood events and the 2006 diesel spill to Silver Creek and Silver Springs. Rieman and McIntyre (1993) suggest that local populations that are in close proximity may experience similar effects from environmental change, while those too far apart would not experience repopulation or genetic input from straying individuals. The Draft Bull Trout Recovery Plan (Service 2004a) has identified a number of recovery actions related to the action area, and the Buckley facility is specified as a priority area for restoring or improving local population connectivity. The Corps has undertaken this challenge through recent commitments to improve upstream fish passage through the replacement of the fish trap. The improved connectivity and passage is expected to provide benefits to the local populations in the core area, allowing the migratory forms (both fluvial and anadromous) better access to foraging, migratory, overwintering, and spawning habitats within the basin. Both fluvial and anadromous life history strategies are important components of the local and core area populations, providing a greater degree of resilience for these populations. Additionally, anadromous individuals tend to have larger body sizes, and they are likely to produce more eggs than resident and fluvial bull trout. McPhail and Baxter (1996) noted that fecundity is a function of body size, with larger female bull trout able to produce more eggs and use a wider range of spawning habitats. With their greater fecundity, the anadromous individuals of the White River bull trout populations are critical to the resilience of the Puyallup core population, particularly with the ongoing and future anticipated effects of climate change.

The proposed action may result in a slight decrease in the number of bull trout individuals in the Puyallup core area's local populations prior to and during construction. Over the long-term, however, the number of bull trout in the Puyallup core area's local populations is likely to remain stable or perhaps increase due to the anticipated improvements in the survival and condition of bull trout that pass upstream through the action area after construction. These improvements are also expected to appreciably improve reproduction and distribution of bull trout over the long-term, and are of particular importance to partially mitigate impacts to the Puyallup core area's local populations from climate change and development facilitated by the continued presence of the dam. For these reasons, the impacts from the proposed action are not expected to appreciably reduce the survival and recovery of the Puyallup core area population, the Coastal-Puget Sound Interim Recovery Unit, and the coterminous range of the species.

Bull trout critical habitat in the White River would be affected by the proposed action, particularly through the sustained lack of LWD passage around MMD. However, LWD recruitment between MMD and the Buckley Dam would continue to enter the White River, and the White and Puyallup Rivers and their tributaries would continue to contribute wood to the lower Puyallup River and estuary. Alternatively, the proposed action would reduce (but not eliminate) physical impediments to upstream bull trout passage within the migratory corridor, resulting in improvements to PCE #6 (Migratory corridors with minimal physical, biological, or water quality impediments). For these reasons, the impacts from the proposed action are not expected to destroy or adversely modify critical habitat by altering the PCEs to such an extent that critical habitat in Critical Habitat Unit 28 (Puget Sound) would not remain functional to serve the intended conservation role for the species.

12.2 Bald Eagles

In the Environmental Baseline and Status of the Species sections, we established that past, present, and future effects of flood control, development, and other activities in the

White/Puyallup River Basins have affected bald eagles through effects to habitat and their prey species. Several nests occur in proximity to the downstream portions of the action area, and the bald eagle pairs associated with these nests are expected to be affected primarily through habitat degradation and disturbance and/or displacement from development activities. Habitat degradation has occurred and will continue to occur. However, we do not expect disturbance from development activities to appreciably impact bald eagles populations in the action area. We anticipate that bald eagles nesting in highly developed or developing portions of the action area would be acclimated to human activities and presence. Consequently, direct and indirect effects to bald eagles as a result of the maintenance and operation of MMD are not expected to be measurable.

During the proposed construction activities at the Buckley facilities, one bald eagle pair is expected to be appreciably affected by the action. Impacts are expected to be in the form of visual and/or sound disturbance to the adults. If the bald eagles are repeatedly disturbed by construction activities, they may abandon the nest or offspring. However, based on the apparent tolerance of this eagle pair, their demonstrated site-fidelity, and their successful production in the past several years during maintenance activities at the Buckley facilities, we do not expect long-lasting effects to the adult bald eagles at this site. Short-term disturbance during construction would be expected to result in the loss of, at maximum, 2 to 2.5 years of production for this pair. However, production would be expected to resume after construction throughout the life span of this bald eagle pair. For these reasons, the impacts from the proposed action are not expected to measurably reduce the survival and recovery of the bald eagle in the Pacific Recovery Area.

13.0 CONCLUSION

After reviewing the current status of bull trout and bald eagles, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the bull trout or bald eagle, and is not likely to destroy or adversely modify designated critical habitat for the bull trout. No critical habitat has been designated for the bald eagle; therefore, none will be affected.

14.0 INCIDENTAL TAKE STATEMENT

Section 9 of the Endangered Species Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behaviors, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

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

14.1 AMOUNT OR EXTENT OF TAKE

The Service anticipates that take of bull trout and bald eagles is likely to result from the proposed action. The incidental take is expected to be in the form of harm and harass for each species.

14.1.1 Bull Trout

Take of bull trout is anticipated to occur during maintenance and operations of MMD and during replacement of the Buckley Dam and the Corps fish trap, as described below. The Service anticipates incidental take of bull trout will be difficult to detect for the following reasons: 1) small individuals may be unobserved; 2) finding a dead or impaired specimen is unlikely due to scavenging, downstream drift, and turbid conditions during part of the year; 3) losses may be masked by seasonal fluctuations in numbers; and 4) aquatic habitat modifications are difficult to ascribe to particular sources, especially in already degraded watersheds. In addition, certain effects of the action are largely unquantifiable in the short term and may only be measurable in long-term effects to the core population. Because the relationship between habitat conditions and the distribution and abundance of individuals in the action area is imprecise, a specific number of individuals taken cannot always be practically obtained. In such circumstances, the Service uses the causal link established between the activities and a change in habitat conditions affecting the species to describe the extent of incidental take as a numerical level of habitat disturbance. When possible and appropriate, the percent of a bull trout life history stage in the action area is used to quantify take.

Incidental take of bull trout is anticipated in the form of ***harm*** *and* ***harassment*** through significant impairment and disruption of essential and normal feeding, migration, foraging, and breeding behaviors from impacts associated with maintenance and operation of MMD. These impacts would occur as a result of flow manipulation at MMD, interruption of LWD transport at MMD, and downstream passage of bull trout through MMD. The life history forms expected to be harmed and harassed by this activity are fluvial and anadromous juvenile, subadult, or adult bull trout. The following take is exempted by this incidental take statement:

> All bull trout present in the White River from the upper extent of the MMD reservoir to the lower Puyallup River and Commencement Bay would be harassed due to flow manipulation and interruption of LWD transport at MMD.
>
> All bull trout passing downstream through MMD would be harassed.
>
> It is anticipated that up to two bull trout would be harmed over the 5-year consultation period as a result of flow manipulation from MMD.[22]
> It is anticipated that up to 5 percent[23] of juvenile bull trout migrating downstream through MMD would be harmed.

Incidental take of subadult and adult bull trout in the form of ***harassment*** *and* ***harm*** would occur through capture, holding, and transport associated with operation of the existing Corps trap-and-haul facility. Operation of this trap-and-haul facility is expected to result in migratory delays, stress, injury, and/or mortality. When the new Corps fish trap is operational, the potential for harm should be significantly reduced, but still may occur due to predation in the trap or other irregular occurrences. The life history forms expected to be harassed and harmed by these activities are fluvial and anadromous bull trout. The following take is exempted by this incidental take statement:

> All bull trout that enter the existing and proposed Corps upstream fish passage facilities and are captured, held, and transported would be harassed.
>
> All bull trout that enter the MIT facility during transference of fish trap operations to the facility during construction and closure of the Corps fish trap and are captured, held, and transported would be harassed.
>
> It is anticipated that up to five bull trout would be injured and/or killed over the 5-year consultation period as a result of operation of the existing Corps fish trap and haul facility or MIT facility during transference of operations from the Corps facility, with the loss of a maximum of one individual per year from the final date of this Opinion until the new Corps fish trap is constructed and begins operation.
>
> It is anticipated that after the new Corps fish trap is operational, up to one bull trout would be killed every 5 years as a result of those operations.

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[22] Bull trout are not expected to be killed as a result of ramping rates every year, as severe subsequent floods that would result in rapid emptying and refilling of the reservoir are expected to be infrequent. We assume that two such events may occur over the 5-year period.

[23] We expect that injury and mortality experienced during downstream passage at MMD would be significantly less than similar impacts at facilities with turbines and spillways and from systems that have more than one facility (e.g., Snake and Columbia River Dams). We also assume that existing impacts would be less than the impacts experienced by salmonids prior to the MMD renovations in the 1990s, and have used the anecdotal information from Heg (1953), Maib and Dunston (1956) and Regenthal and Rees (1957) as the best available scientific data available for this system, although we recognize the limitations of their data for our analysis.

Incidental take of bull trout in the form of ***harassment*** is anticipated due to the disruption of migrating and foraging behaviors. This form of incidental take is anticipated at and downstream of the Buckley Dam and fish trap construction site. The extent of take is expected to be all bull trout associated with the wetted area of the river, from the project site, to an area 600 ft downstream, during installation and removal of each of the cofferdams and other sediment-generating activities. Sediment-generating activities, and the installation and removal of each cofferdam are expected to take up to 10 days, for 8 hours per day. The life history forms anticipated to be harassed are anadromous and fluvial subadult and adult bull trout. The duration of take is anticipated to be any time that excavation and substrate disturbance occurs in the White River at the Buckley construction site, which is expected during the time between July 15 and August 31. Take would occur during the following conditions:

1) When background NTU levels are exceeded by 110 NTUs at any time.
2) When background NTU levels are exceeded by 41 NTUs for between 1 and 3 hours.
3) When background NTU levels are exceeded by 15 NTUs for more than 3 hours.

Incidental take of subadult and adult bull trout in the form of ***harm*** and ***harassment*** would occur through physical injury or death caused by capture and handling (harm) or a significant disruption of normal behaviors (harass) as a result of electrofishing and netting operations during fish salvage for the placement of the cofferdam and isolation of the construction site. The following take is exempted by this incidental take statement:

> All bull trout that are captured, held, and transported from within the cofferdam during fish salvage would be harassed.
>
> It is anticipated that up to one bull trout would suffer sublethal or lethal injuries during the fish salvage process. The number of bull trout exempted for killing by this incidental take statement is one individual over the course of the 5-year consultation period.

14.1.2 Bald Eagle

Incidental take of bald eagles is anticipated in the form of ***harm*** through injury from the impacts associated with construction and maintenance of the project in the nesting territory. The Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein. The following take is exempted by this incidental take statement:

> Two bald eagle eggs, nestlings, or juveniles are expected to be harmed each year from impacts associated with increased flushing of adult bald eagles, reduced nest attendance by adult bald eagles, potential premature fledging, and increased

exposure to the elements during up to 2.5 years of construction during replacement of the Buckley Dam and Corps fish trap, potentially three nesting seasons.

Incidental take of bald eagles is anticipated in the form of ***harassment*** through significant disruption of normal feeding (during nesting and wintering), and breeding behaviors from impacts associated with construction and maintenance of the project. The following take is exempted by this incidental take statement:

> Two adult bald eagles are expected to be harassed each year over the 2.5 years of construction as a result of construction-related disturbance, for potentially three nesting seasons.

14.2 EFFECT OF THE TAKE

In the accompanying Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the bull trout or bald eagle or destruction or adverse modification of critical habitat for the bull trout.

14.3 REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures (RPM) are necessary and appropriate to minimize take of Puget Sound/Coastal bull trout and bald eagles.

1. Reduce impacts to downstream migration of bull trout during maintenance and operations of the Corps facilities.
2. Minimize turbidity and release of contaminants during the replacement of the Buckley Dam and Corps fish trap and upgrades to the MIT facility.
3. Minimize injury and mortality of bull trout from fish salvage operations inside cofferdam during construction.
4. Minimize injury and mortality from fish handling and trap-and-haul operations at the Corps fish trap and MIT fish trap when fish trap operations are transferred to the MIT facility during construction.
5. Increase habitat complexity by increasing transport of stored LWD to areas below MMD.
6. Minimize bald eagle disturbance from replacement of the Buckley Dam and Corps fish trap and upgrades to the MIT facility.
7. Monitor implementation and effectiveness of all conservation measures described in the project description of the Opinion, as well as the aforementioned RPM and their accompanying Terms and Conditions.

14.4 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements.

1. To implement RPM #1, the Corps shall:

   A. Coordinate with U.S. Geological Survey, the Service, and NMFS to design, install, and operate real-time streamflow gaging in the vicinity of the Buckley fish trap-and-haul facility to ensure sufficient flows for efficient operation of the Corps fish trap.

   B. Implement a monitoring study at MMD to test assumptions regarding downstream passage success and injury/mortality rates. The study must be approved by both the Service and NMFS.

2. To implement RPM #2, the Corps shall:

   A. Monitor downstream turbidity levels in the White River during sediment-generating activities related to the Buckley Dam replacement.

      i. Monitoring shall occur 600 ft downstream from the project site.

      ii. Monitoring shall occur at three locations along a transect that extends perpendicular to the stream flow, when conditions are not deemed hazardous to human safety.

      iii. Monitoring shall occur at 15 minute intervals during all activities that generate turbidity. Once sediment-generating activities have stopped and turbidity levels have reached background levels, monitoring may cease.

   B. Monitor upstream (at least 100 ft) of the construction area to establish background turbidity levels. Background turbidity levels would be measured every 3 hours while in-water work is occurring.

   C. If sediment levels exceed background levels at and/or beyond the downstream monitoring site[24] by the amounts and durations listed below, then the amount of take authorized by the Incidental Take Statement will have been exceeded and the Corps must reinitiate consultation. The Corps shall take corrective action to reduce sedimentation and shall contact Western Washington Fish and Wildlife Office in Lacey, Washington (360-753-9440).

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[24] The Amount and Extent of Take for sediment impacts described previously exempts take for all bull trout in the White River from the Buckley construction site to 600 ft downstream of the project site. If background NTU levels are exceeded as described at or beyond the monitoring site (600 ft downstream of the site), incidental take would be exceeded.

i. When background NTU levels are exceeded by 110 NTUs at any time.

ii. When background NTU levels are exceeded by 41 NTUs for between 1 and 3 hours.

iii. When background NTU levels are exceeded by 15 NTUs for more than 3 hours.

D. If tubidity levels begin to approach these limits, or if turbidity limitations established by the Washington State Department of Ecology's Water Quality Certification for these projects are exceeded, the Corps will contact the Service's consultation biologist to discuss means of assuring that the authorized amount of incidental take is not exceeded.

E. Provide a report to the Service on an annual basis describing the monitoring protocols used and results of the surveys, including any exceedences, by December 31st of each reporting year. The report should include:

1) Dates and times of activities that generated sediments.

2) Identification of the construction activities and downstream NTUs associated with the activities.

3) Any corrective actions taken.

4) Any reporting requirements of the 401 State Water Quality Permit issued for this project.

5) If no sediment is generated during the construction season, then no report is necessary. An email to the consulting biologist is sufficient noting that no sediment-generating activities occurred during that year.

F. Develop and implement an Erosion and Sediment Control Plan prior to the construction of the Buckley Dam. All reasonable measures for the prevention of erosion shall be included in the plan to eliminate sediment input into the White River in the short and long term.

i. Inspection of erosion controls. During construction, all erosion controls must be inspected daily during the rainy season and weekly during the dry season to ensure they are working.

a. If inspection shows that the erosion controls are ineffective, work crews must be mobilized immediately to make repairs, install replacements, or install additional controls as necessary.

b. Sediment must be removed from erosion controls once it has reached 1/3 of the exposed height of the control.

G. Equipment storage, staging, or refueling should not occur within 150 ft or more from any stream, waterbody, or wetland.

H. All vehicles operated within 150 ft of any stream, waterbody, or wetland must be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected must be repaired in the vehicle staging area before the vehicle resumes operation. Inspections must be documented in a record that is available for review on request by the Service.

I. All equipment operated instream must be cleaned before beginning operations below the bankfull elevation to remove all external oil, grease, dirt, and mud.

3. To implement RPM #3, the Corps shall:

A. Capture and release all fish before and intermittently as needed during pumping to isolate an in-water work area using trapping and seining to minimize risk of injury.

i. A qualified fisheries biologist shall ensure the safe handling of all bull trout from the isolated area.

ii. The capture team must handle ESA-listed fish with extreme care, keeping fish in water to the maximum extent possible during seining and transfer procedures to prevent impacts from exposure and added stress of out-of-water handling.

iii. If dip nets are used to capture or move bull trout, they should be sanctuary type nets, with solid bottoms to allow minimal dewatering of bull trout.

iv. If netting and seining are not sufficient to collect all fish, electrofishing equipment may be used as contingency to capture fish. If electrofishing equipment is used, the capture team must comply with NMFS electrofishing guidelines.

v. Captured fish must be released as near as possible to capture sites.

vi. The Service or its designated representative must be notified 24 hours in advance of capture and release activities to allow for observation of such activities.

4. To implement RPM #4, the Corps shall:

   A. Design, construct, and operate the Corps' new upstream fish trap in collaboration with the Service and NMFS fish passage engineers.

      i. The adult fish handling system shall have 1) at least three holding raceways or ponds, each with a minimum capacity of 100 individuals, and 2) a fish sampling and sorting table.

      ii. Dip nets shall not be used in routine operations. In emergency situations, dip nets may be used to prevent mortality, but only in emergency situations. Where possible, sanctuary nets should be used to minimize out-of-water impacts to bull trout.

      iii. During periods of higher returns of pre-spawning fish (i.e., greater than 50 individuals/day), bull trout shall not be crowded together with larger species.

         a. During fish trap operations, bull trout shall be held separately from larger fish (e.g., Chinook salmon) or more numerous fish (e.g., pink salmon).

         b. Bull trout shall be transported and released above MMD separately from other larger or more numerous salmonids.

      iv. During periods of lower returns of fish (i.e., less than 50 individuals/day), bull trout may be transported to the release site above MMD with other salmonids.

   B. Implement NMFS fish handling guidelines in all phases of the new and existing Corps trap-and-haul operations and the trap-and-haul operations at the MIT facility when operations are transferred to the MIT facility during the proposed construction, including the following:

      i. If dip nets are used to capture or move bull trout, they should be sanctuary-type nets, with solid bottoms to allow minimal dewatering of fish. Fish must be handled with extreme care.

      ii. At minimum, bull trout must be removed from the traps daily from June through September, with the following exceptions:

         a. Bull trout shall be removed from the trap more frequently when:

            (i) Water temperature extremes (≥15°C) are present in the White River in the vicinity of the trap.

(ii) Crowding occurs in the trap (>50 fish) and/or below the trap during migration peaks of bull trout and other salmonid species).

b. Weekends and/or holidays may be exempted from trap operations if no more than 50 fish[25] are anticipated to access and hold in the trap prior to the next trap operation date, based on data from the preceding 5 days.

iii. Individuals handling fish must be experienced or trained to assure fish are handled safely.

C. Ensure data collection is accurately and consistently reported at the existing and new Corps fish trap and at the MIT facility when operations are transferred to the MIT facility during the proposed construction. Reported data should include the following:

i. Accurate identification and enumeration of fish captured in the trap each day.

ii. Documentation of each of the transport trips that contain bull trout, when more than one daily trip is necessary. This data should also include how many bull trout and other salmonids were present in the transport truck during each trip.

iii. Documentation of dissolved oxygen and temperature readings of source water for the truck (at the trap), in the transport tank, and White River stream temperatures at the release site.

iv. Confirmation that the release flume remains wetted until the last fish of each transport load is released.

v. Documentation of any noticeable injury or mortality of bull trout at any stage of the trap-and-haul operation.

D. Implement a monitoring study at MMD to test assumptions regarding upstream passage success of bull trout. The study must be approved by the Service.

5. To implement RPM #5, the Corps shall:

A. Ensure all small woody debris and LWD entrained on or collected upstream of the Buckley Dam during maintenance and operation is placed or released whole downstream of the Buckley Dam. If a single piece of LWD is too large or heavy to be passed over the dam with heavy equipment operated from the land or maintenance deck, a minimum number of cuts necessary to enable transport is

[25] An average of approximately 100 fish would be considered a full truck-load of fish for transport purposes.

allowable. However, the LWD shall not be cut into small pieces before being released downstream.

B. Coordinate with the Service and NMFS to create at least two substantial engineered log jams in the White River below the Buckley Dam to provide for the formation of pools and habitat features and/or processes and natural resource inputs.

   i. Design and implement a monitoring plan in coordination with the Service and NMFS to determine short- and long-term success of the installation of the engineered log jams.

C. Create a long-term LWD management plan in cooperation with other Federal, Tribal, State, local, and private partners. The plan should include a strategy for the redistribution of the LWD that accumulates and is stored above MMD to locations within the White/Puyallup River Basin. The plan should also ensure that the LWD is retained within the White/Puyallup River Basin to support the formation of pools and habitat features and natural processes in the action area.

6. To implement RPM #6, the Corps shall:

   A. The Corps shall not conduct any pile driving or activities with similar sound levels at the Buckley facilities from the start of the bald eagle nesting period (January 1) until the bald eagles have fledged their young.

   B. A qualified biologist shall monitor the bald eagle pair during construction activities that overlap with the bald eagle nesting season to document construction-related disturbance.

   C. A qualified biologist shall monitor the bald eagle pair for at least one additional year after construction is completed to determine whether the construction activities resulted in displacement of the bald eagles from their nest.

   D. Provide an annual report each year that monitoring occurs, due no later than December 31, of the given year.

7. To implement RPM #7, the Corps shall:

   A. Provide a written report on an annual basis, due to the Service no later than December 31.

   B. The report should include all monitoring and the success of implementing the RPMs and their effectiveness as outlined in the Opinion.

In addition, the Service is to be notified within three (3) working days upon locating a dead, injured, or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office (425) 883-8122, followed by notification of the Western Washington Fish and Wildlife Office (360) 753-9440. Notification must include the date, time, precise location, and condition of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed.

15.0 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to use their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of threatened and endangered species. Conservation recommendations are discretionary measures suggest to minimize or avoid adverse effects of a proposed action on listed species, to minimize or avoid adverse modification of critical habitat, or to develop additional information.

The Service recommends the following:

- The Corps should coordinate with PSE, the Puyallup and Muckleshoot Tribes, NMFS, WDOE, the Service, and other stakeholders to develop long-term minimum instream flow requirements in the White River below the Buckley Dam that are protective of bull trout migration, foraging, and overwintering. Such coordination should be initiated as soon as possible and prior to completion of the Buckley Dam. Although the Corps is not directly responsible for the amount of flows that are diverted to Lake Tapps, the existence of the replacement Buckley Dam, which will be owned by the Corps, will facilitate pooling behind the Buckley Dam and subsequent diversion of flows. A desired and critical goal of this coordination would be the installation of gages to monitor and report flows in the diversion flume and in the White River downstream of the rock bypass chutes.

- The Corps should coordinate with WDOE to establish a stream temperature monitoring station at the Buckley facility to monitor short- and long-term temperature trends in this section of the White River.

- The Corps should coordinate with other entities studying the Puyallup core population and the Service to analyze genetic samples from bull trout to gain a better understanding of the White and Puyallup River bull trout populations.

- The Corps should replace the existing fish release flume above MMD with a rounded half- or full-pipe flume to provide better water depth spread and delivery for bull trout and other salmonids released from the flume and to prevent any fish from splashing out of the flume. Any replacement flume should be constructed of a smooth material (e.g., PVC) that does not rust to reduce the potential for abrasion during release. The

Corps should also consider a release site upstream of the existing release site to further reduce the potential for fallback of released fish.

- The Corps should construct most if not all of their new fish trap during the first part of the construction period, prior to the construction-related closure of the Corps' existing fish trap. If the existing Corps fish trap must be decommissioned before the new fish trap can become operational, transference of fish trap operations to the MIT facility would still be possible and would likely be shorter in duration than is currently anticipated. Bull trout and other salmonids (and the Corps and Tribal staff that operate the facility) would benefit from use of the new facility during construction in several ways. First, delays or other foreseen circumstances associated with construction could be managed more efficiently without the need to avoid transference of fish passage operations to the MIT facility during higher returns of fish. Secondly, although the Corps may be willing to adhere to performance standards and other contingencies (e.g., additional staffing, longer hours, additional trips, etc.) related to use of the smaller MIT facility, the use of the new Corps fish trap during closure of the existing fish trap would avoid the need for some of these contingencies. Furthermore, bull trout and other salmonids would realize benefits sooner from the improved conditions during operation of the new Corps fish trap (described in the Effects of the Action section above).

16.0 REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the request. 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 not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. Circumstances in which such instances might occur include (but are not limited to) the following:

- Failure of the project to meet performance standards for bull trout as outlined in the project description such that incidental take occurs or could occur in a manner or extent not considered in this Opinion. For example, if results from downstream or upstream fish passage studies indicate a level of take that exceeds the assumptions described in effects analysis, the Corps should confer with the Service to determine whether reinitiation is necessary.

- If either of the following occur:

    - Instream flow requirements for the White River are decreased below levels specified in the existing interim operating agreement (Table 3).

    - The interim operating agreement is discontinued prior to the establishment of White River instream flow requirements that are at least as equally protective of bull trout as the flows in the interim operating agreement. Effects to bull trout from the proposed action were evaluated based on instream flow levels no lower than those in the interim operating agreement. The pending WDOE Report of Examination specifies instream flow levels that are more protective of bull trout than the flows in the interim operating agreement, and we support this increase in flow requirements to better support bull trout foraging, migration, and overwintering in the action area. We anticipate that the required instream flows will be, at minimum, those specified in WDOE’s draft document. While we recognize that the Corps has no control over WDOE's actions, effects from the Corps' proposed action may become more significant to bull trout in the Puyallup core area, Puget Sound Interim Recovery Unit, and the coterminous population if instream flow requirements are reduced below those currently specified in the existing interim operating agreement.

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FIGURES

APPENDICES