Daniel M. Mathis  
Division Administrator  
Federal Highway Administration  
Evergreen Plaza Building  
711 Capitol Way South, Suite 501  
Olympia, Washington 98501-1284  

ATTN: Randy Everett  

Dear Mr. Mathis:

This document transmits the U.S. Fish and Wildlife Service’s Biological Opinion (Opinion) based on our review of the proposed State Route 520 Pontoon Construction Project in Grays Harbor and King Counties, Washington, and its effects on the bull trout (Salvelinus confluentus), marbled murrelet (Brachyramphus marmoratus), and bull trout critical habitat, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act).

Your request for initiation of formal consultation, dated July 23, 2010, was received in our office on July 26, 2010. The Federal Highway Administration provided information in support of “may affect, likely to adversely affect” determinations for the bull trout, marbled murrelet, and bull trout critical habitat. On October 28, 2010, we received additional information from the Washington State Department of Transportation and Federal Highway Administration identifying conservation measures that would avoid adverse effects to the marbled murrelet.

The enclosed Opinion addresses the proposed action’s adverse effects on the bull trout and bull trout critical habitat, and includes mandatory terms and conditions intended to minimize certain adverse effects. The Opinion finds that the action’s effects on the marbled murrelet, its habitat, and prey base are insignificant and that no measurable effects to the marbled murrelet are anticipated.
If you have any questions regarding the Opinion or your responsibilities under the Endangered Species Act, please contact Ryan McReynolds at (360) 753-6047 or Emily Teachout at (360) 753-9583 of this office.

Sincerely,

[Signature]

Ken S. Berg, Manager
Washington Fish and Wildlife Office

cc:
FHWA, Seattle, WA (R. Everett)
WSDOT, Seattle, WA (A. Hanson)
WSDOT, Seattle, WA (M. Meade)
WSDOT, Olympia, WA (P. Wagner)
Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION
U.S. Fish and Wildlife Service Reference: 13410-2010-F-0497

State Route 520 Pontoon Construction Project

Grays Harbor and King Counties, Washington

Agency:
Federal Highway Administration
Olympia, Washington

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

Ken S. Berg, Manager
Washington Fish and Wildlife Office

Date 12-6-10
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<td>Best Management Practices</td>
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<td>Mean higher high-water</td>
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<td>Total suspended solids</td>
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<td>Temporary Threshold Shift</td>
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CONSULTATION HISTORY

The Washington State Department of Transportation (WSDOT) and Federal Highway Administration (FHWA) are implementing a design-build strategy for expediting production of floating bridge pontoons. The proposed project includes emergency preparedness and repair activities in the event of a catastrophic failure of the State Route (SR) 520 floating bridge across Lake Washington in King County, Washington. The following elements are proposed as part of the SR 520 Pontoon Construction Project:

- Build and operate a pontoon construction facility located at the Aberdeen Log Yard (ALY) site near the mouth of the Chehalis River in Grays Harbor County;
- Store completed pontoons at moorage locations in Grays Harbor;
- Outfit and deliver finished pontoons, and associated over-water bridge components, to Lake Washington via open-water shipping routes and the Lake Washington Ship Canal; and,
- In the event of a catastrophic failure, conduct emergency repair of the existing SR 520 floating bridge span to reestablish the as-built, four-lane configuration in its current alignment.

The proposed pontoon construction facility, and the finished pontoons it produces, are “forward-compatible” with preliminary designs for the planned full replacement of the SR 520 floating bridge. The “SR 520 Interstate-5 to Medina Bridge Replacement and HOV Project” addresses those future designs, and the FHWA has determined that action has independent utility. As such, the FHWA is completing a separate environmental review and approval process for that action.

The proposed project is funded in-part by the FHWA, and will require a Clean Water Act section 404 permit from the U.S. Army Corps of Engineers. Federal funding and issuance of a section 404 permit establish a nexus requiring consultation under section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act).

The U.S. Fish and Wildlife Service (Service) based this Biological Opinion (Opinion) on the following sources of information: the Biological Assessment (BA), dated July 2010 and received July 26, 2010; exchanges of information dated October 20, October 28, and November 16, 2010; a field review of the project site; and various scientific literature and personal communications cited herein. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

The following timeline summarizes the history of this consultation:

Spring 2000 through Fall 2010 – The Service provides technical assistance through early involvement during the NEPA (National Environmental Policy Act), SAC (Signature Agency Committee), and SAFETEA-LU (Safe Accountable Flexible Efficient Transportation Equity Act) environmental review processes.
March 2008 through July 2010 – The WSDOT and the Service engage in regular, twice monthly meetings and conference calls to discuss design issues, conservation measures, information needs in support of consultation, and other related matters in advance of the formal consultation period.

July 26, 2010 – The FHWA submits a BA providing information in support of “may affect, likely to adversely affect” determinations for the marbled murrelet (Brachyramphus marmoratus), bull trout (Salvelinus confluentus), and designated bull trout critical habitat.

August 17, 2010 – The Service transmits a draft letter providing their tentative rationale in support of a revised “may affect, not likely to adversely affect” determination for the marbled murrelet.

September 27, 2010 – The FHWA responds with a draft letter acknowledging a revised “may affect, not likely to adversely affect” determination for the marbled murrelet.

October 20, 2010 – The Service transmits a request for annual inspections of the pontoon moorage system (rafts, anchor chains/ cables) to prevent fishing gear entrainment and related potential effects to the marbled murrelet.

October 28, 2010 – The FHWA responds to confirm the project will perform an annual field inspection for entrained fishing gear.

**CONCURRENCE FOR MARBLED MURRELET**

The proposed project would build and operate a pontoon construction facility near the mouth of the Chehalis River, store completed pontoons at moorage locations in Grays Harbor, outfit and finish pontoons at existing port/ industrial facilities in Grays Harbor, and transport finished pontoons to Lake Washington via open-water shipping routes and the Lake Washington Ship Canal. The project would also complete compensatory mitigation for unavoidable wetland/ buffer and aquatic resource impacts at the “Grass Creek” site, and would utilize existing, permitted and approved Dredged Material Management Program (DMMP) open-water disposal sites in Grays Harbor. Figure 1 identifies the locations of proposed activities in Grays Harbor, Washington.
Risk of Exposure

Thorough marbled murrelet survey data are lacking for much of the action area. Available summer and winter survey data document low numbers throughout the year, which are generally near the mouth of Grays Harbor (Lance et al. 2008; 2009; Pearson et al. 2010; Speich and Wahl 1995; Thompson 1997a; Thompson 1997b; 1999). While most of this survey effort has been focused near the mouth and extending to waters beyond the continental shelf, Thompson et al. (1997a; 1997b) did survey Grays Harbor’s interior waters and consistently failed to document marbled murrelets more than a few miles from the mouth.

Available anecdotal data, including Christmas bird counts conducted from 1995 to 1999, and again in 2009 (D. Moore, pers. comm. 2010 in WSDOT 2010a, p.4-22), place nearly every documented occurrence of the species close to the mouth of Grays Harbor (i.e., at the “Bottle Beach”, “John’s River Road”, or “Ocean Shores” bird count stations). Marbled murrelets have not been observed on the north side of Grays Harbor during Christmas bird counts or otherwise (D. Moore, pers. comm. 2010 in WSDOT 2010a, p. 4-22). The Washington State Department of Fish and Wildlife (WDFW) reports that no marbled murrelets have been observed on or in the vicinity of the ALY site (J. Jenkerson, pers. comm. 2010 in WSDOT 2010a, p. 4-22).

Within the action area surrounding the ALY site, Grays Harbor exhibits a strong riverine influence and high ambient levels of disturbance associated with heavy industrial and maritime uses. Foraging habitats are heavily degraded as a result of excessive sedimentation, poor water and sediment quality, and human alteration of the shorelines and mudflats (including routine
dredging of the entire navigation channel). Available data and best professional judgment lead us to conclude that marbled murrelets are extremely unlikely to occur in close proximity to the ALY site. However, marbled murrelets may be exposed to those temporary stressors that extend the greatest distance from the site (e.g., elevated sound resulting from upland impact pile driving and proofing).

The action area surrounding the open-water pontoon moorage site is much closer to the mouth of Grays Harbor, where marbled murrelets have been documented (Thompson 1997a, pp. 31, 43, 47; Thompson 1997b, p. 10). Available data and best professional judgment lead us to conclude that marbled murrelets may be exposed to temporary or permanent stressors resulting from pontoon moorage.

This action includes delivery of finished pontoons along open-water shipping routes, and therefore these shipping routes are included as part of the action area. Pontoon transport will result in temporary noise and vibration, but will otherwise have no incremental long term effects on the physical, biotic, or chemical environment.

**Response to Exposure**

Construction activities and operations at the ALY site (casting basin and launch channel) will result in temporary stressors, including elevated in-air and underwater sound, and degraded water quality. These stressors will be limited in both physical extent and duration, with most measurable short term effects confined to a localized area near the ALY site at the mouth of the Chehalis River. Given the location, nature, and duration of proposed work at the ALY site, we expect that temporary exposures with the potential to cause marbled murrelet injury or mortality are extremely unlikely and therefore discountable.

The selected moorage site and design reduces the potential for impacts to biological resources. The moorage site is located in waters ranging in depth from 25 to 65 ft, within a dynamic portion of Grays Harbor characterized by relatively high tidal currents, high rates of sediment transport, and little or no well-established aquatic vegetation or macroalgae. A taut-line mooring system with plate anchors will leave only the anchor chain visible at the substrate surface and will minimize anchor chain/ cable drag and disturbance.

The project plans to conduct monthly field inspections of the moored pontoon rafts. The WSDOT and FHWA have also committed to once-annual video reconnaissance or dive inspections of the mooring system (anchor chains/ cables) for the purpose of discovering and removing any entrained fishing gear (e.g., drift nets, gill nets). The project will perform the annual inspection after the close of the Grays Harbor tribal and commercial fishing seasons, during December of each year that pontoon rafts remain at moorage (Bloch, Pers Comm, 2010ba). The WSDOT and FHWA will report their observations to the Service within 30 days of inspection, and the plans for removing any entrained fishing gear in a timely manner. We therefore conclude it is extremely unlikely that a marbled murrelet would become entangled in any entrained fishing gear.
With implementation of the proposed conservation measures, we expect that construction activities and operations at the selected pontoon moorage site will have no measurable effect on normal marbled murrelet behaviors, their prey base, or habitat. Temporary underwater sound and turbidity produced when installing plate anchors with a vibratory hammer will be short duration (intermittent; two to four working days per raft), and will not be detectable to a significant distance. Any localized changes in sediment transport, scour, and deposition will have no measurable effect on the benthic and infaunal community or submerged vegetation and macroalgae. Moored rafts may support a biofouling community attractive to foraging fish, but we do not expect this will prompt any response from marbled murrelets that may forage near the mouth of Grays Harbor. Pontoon moorage will have no measurable short or long term effects on marbled murrelet individuals, their prey base, or habitat.

While marbled murrelets may be exposed to temporary noise and vibration associated with pontoon transport, we do not expect that these intermittent exposures will result in measureable effects to normal marbled murrelet behaviors. And, while we cannot entirely discount the risk of transporting invasive species from Grays Harbor to parts of the Puget Sound, no related measurable effects to marbled murrelets, their prey base, or habitat are foreseeable and reasonably certain to occur.

The proposed action will have no measurable long term or permanent effects to suitable marbled murrelet foraging habitat, and the action will not measurably affect marbled murrelet foraging behaviors or movement through the action area. Given the location, nature, and duration of proposed work, we expect that temporary exposures will not measurably affect individuals, their prey base, or habitat, and are therefore insignificant.
DESCRIPTION OF THE PROPOSED ACTION

The WSDOT and FHWA are implementing a design-build strategy for expediting production of floating bridge pontoons. The proposed project includes emergency preparedness and repair activities in the event of a catastrophic failure of the SR 520 floating bridge across Lake Washington in King County, Washington. The SR 520 Pontoon Construction Project includes the following elements:

- Build and operate a pontoon construction facility (casting basin, launch channel, and associated infrastructure) at the ALY site near the mouth of the Chehalis River in Grays Harbor County;
- Store completed pontoons at moorage locations in Grays Harbor;
- Outfit pontoons with associated over-water bridge components at existing port/industrial facilities along the north shore of Grays Harbor;
- Construct compensatory mitigation for unavoidable wetland/buffer and aquatic resource impacts at the Grass Creek site in Grays Harbor;
- Deliver finished pontoons to Lake Washington via open-water shipping routes and the Lake Washington Ship Canal (Chittenden Locks to Montlake Cut); and,
- In the event of a catastrophic failure, conduct emergency repair of the existing SR 520 floating bridge span to reestablish the as-built, four-lane configuration in its current alignment.

The proposed pontoon construction facility, and the finished pontoons it produces, are “forward-compatible” with preliminary designs for the planned full replacement of the SR 520 floating bridge. The “SR 520 Interstate-5 to Medina Bridge Replacement and HOV Project” addresses those future designs, and the FHWA has determined that action has independent utility. As such, the FHWA is completing a separate environmental review and approval process for that action. Also, the project will use DMMP open-water disposal site(s) near the mouth of Grays Harbor as an interrelated action. Operation of the DMMP site(s) has undergone independent section 7 consultation (FWS Ref. No. 1-3-06-I-0469; Grays Harbor and Chehalis River Navigation Channel Maintenance Dredging Program, FY2007-2011).

The project’s legal location is: Sections 7, 8, 17, and 18, Township 17 North, Range 9 West (ALY site); Townships 16 and 17 North, Range 11 West (moorage site); Sections 7, 17, and 18, Township 17 North, Range 9 West AND Section 10, Township 17 North, Range 10 West (Port of Grays Harbor facilities/terminals T1-T4); Section 36, Township 18 North, Range 11 West (Grass Creek site); and, Sections 22 and 24, Township 25 North, Range 4 East (current floating bridge alignment).
Figure 2. Vicinity map; proposed activities/ locations in Grays Harbor.

Figure 3. Vicinity map; proposed activities/ locations in Lake Washington.
The sub-sections that follow discuss in greater detail the following project elements and items of work: construction of the casting basin, launch channel, and associated infrastructure at the ALY site; maintenance and operations at the completed pontoon construction facility; production of floating bridge pontoons; moorage and transport of bridge pontoons; outfitting of bridge pontoons; mitigation; and, emergency repair of the existing floating bridge span.

Project Elements and Items of Work

Construction of the casting basin, launch channel, and associated infrastructure at the ALY site is scheduled to begin early 2011 and to be complete by early 2012. Production of pontoons will begin late 2011 (or early 2012) and will continue through early 2014. Unless they are needed sooner in response to catastrophic failure of the existing floating bridge span, completed pontoons will remain in storage at moorage locations in Grays Harbor until commencement of the planned full replacement of the SR 520 floating bridge.

Construction of the Casting Basin, Launch Channel, and Infrastructure

The ALY site near the mouth of the Chehalis River in Grays Harbor County, has been the site of sawmill, log storage, and sorting operations for more than eighty years. The site is approximately 44 acres in size, with a Puget Sound and Pacific rail line to the north, and a municipal wastewater treatment plant to the east. Much of the site lies on fill placed within the historic floodplain, the shoreline and adjacent mudflats have been substantially altered (through placement of armor and piles), and relatively little native vegetation remains (Figure 4).

The proposed project would develop the entirety of the ALY site, with construction of an approximately eight acre casting basin, concrete batch plant, stormwater and process water treatment facilities, office, parking lot, and associated infrastructure (including saw shop, fabrication yard, and large laydown and stockpile areas) (Figure 5).

Construction activities completed landward of the Mean Higher High-Water Mark (MHHW) include site grading and preparation, excavation of the casting basin footprint and landward launch channel, construction of the temporary and permanent site dewatering, drainage, stormwater and process water treatment systems, and construction of the casting basin floor (pile-supported concrete slab), armored side slopes, work trestle, and tower crane rails. Upland construction activities will require approximately 300 working days.

Construction activities will produce approximately 360,000 cubic yards (cy) of excess fill. The project will implement temporary erosion and sediment control and spill prevention, control, and countermeasure plans, including appropriate best management practices (BMPs) to ensure containment, proper storage, handling, and disposal of any contaminated media (soils, fill, or groundwater). Construction activities will comply with the terms of a National Pollutant Discharge Elimination System (NPDES) General Construction Permit.
Figure 4. Aerial photo of ALY site in its present condition.

Figure 5. Preliminary ALY site development plan.
Preliminary designs for the site dewatering, drainage, stormwater and process water treatment systems include four stormwater detention and treatment ponds, one groundwater pond, and two process water treatment ponds. All discharges from the developed site will be directed to the existing, vegetated drainage ditches at the periphery of the site or to the new outfall(s) constructed within the footprint of the facility’s launch channel.

The project will place as many as 2,200 permanent 18- to 24-inch diameter steel piles within the excavated footprint of the casting basin floor and work trestle(s). The project will install the piles with the use of both vibratory and impact pile hammers.

At completion, the developed ALY site will include approximately 32.8 acres of pollution-generating impervious surface. The site’s operations will comply with the WSDOT’s Highway Runoff Manual and with a NPDES General Sand and Gravel Permit issued for the project by the Washington State Department of Ecology (WDOE). A sub-section that follows discusses stormwater and process water treatment in greater detail (see Maintenance and Operations at the Completed Pontoon Construction Facility).

The proposed project will construct and maintain a launch channel extending approximately 430 ft, from the existing shoreline (or MHHW) to the lower Chehalis River/Grays Harbor navigation channel. Construction of the launch channel will require an initial dredge operation removing approximately 87,000 cy, installation of approximately 70 permanent steel and wood piles, and placement of approximately 18,000 cy of clean riprap armor (along the tapered channel sideslopes) (Figure 6).

Figure 6. Preliminary ALY site development plan.
All construction activities waterward of the MHHW will be completed during the established in-water work window for these portions of Grays Harbor (June 16 through February 28). Initial dredge of the launch channel footprint is scheduled for early winter 2011-2012 and will require approximately 60 working days. Dredging operations will use an environmental clamshell bucket operating from a barge(s), except where site conditions or obstructions (e.g., wood piles or wood waste) require use of a conventional bucket. The project will use a vibratory hammer or direct pulling to remove approximately 32 wood piles from the launch channel footprint, will implement BMPs to minimize release of sediment to the surrounding waters, monitor for compliance with aquatic life turbidity criteria at the edge of the allowable mixing-zone (300 ft), and will properly contain, test, transport, and dispose of all dredged/ excavated material according to DMMP protocols and standards. Authorized use of the DMMP open-water disposal site(s) near the mouth of Grays Harbor is an interrelated action, but one that is subject to independent section 7 consultation (FWS Ref. No. 1-3-06-I-0469). At completion of the initial dredge operation, the project will perform sample analyses to confirm that surficial sediments meet sediment quality standards.

The project will place approximately two 60-in diameter steel piles and four 30-in diameter steel piles at the waterward limit of the launch channel. These permanent piles will serve as “turning dolphins”. The project will also place approximately fifty permanent 24-in diameter steel piles for the launch channel fender or rub rails, two permanent 18-in diameter steel piles and ten untreated timber piles for navigational markers at the edge of the launch channel footprint. All piles placed below the MHHW will be installed with a vibratory hammer to the fullest extent practicable. If site conditions require the use of an impact pile hammer, the project will implement a sound attenuation system (i.e., bubble curtain) and underwater sound monitoring plan.

Maintenance and Operations at the Completed Pontoons Construction Facility

Once built and fully operational, the casting basin and launch channel will be used to construct approximately thirty-three floating bridge pontoons in six cycles between winter 2012 and spring 2014. A sub-section that follows discusses pontoon construction, launching, and related activities (e.g., basin dewatering and fish handling) in greater detail (see Production of Floating Bridge Pontoons). This section discusses maintenance and operations over the period 2012 – 2014, including treatment systems for storm and process water, maintenance dredge operations, and dormancy after completion of the planned six cycles of pontoon construction.

The project will provide basic treatment for all stormwater runoff originating from pollution-generating impervious surface at the developed ALY site (approximately 33 acres). Preliminary designs include wet ponds and biofiltration swales meeting the Highway Runoff Manual 6-month/24-hour design standard (WSDOT 2010a, pp. 2-16, 2-17). Discharges will be directed to vegetated ditches at the periphery of the site or to new outfalls constructed within the footprint of the launch channel. Stormwater discharges will comply with the aquatic life turbidity criteria established for this portion of the lower Chehalis / Grays Harbor, i.e., less than 10 nephelometric turbidity units (NTU) over background at the point of compliance or “mixing-zone” boundary (300 ft).
The project will treat all process water (batch plant process water and curing water) for control of temporary suspended solids (TSS) and pH consistent with NPDES General Sand and Gravel Permit requirements. Preliminary designs include treatment ponds meeting the 10-year/24-hour design standard, chitosan systems, and carbon dioxide sparging for control of pH (WSDOT 2010a, pp. 2-16, 2-17). Discharges will be directed to vegetated ditches at the periphery of the site or to new outfalls constructed within the footprint of the launch channel. Process water discharges will not exceed 50 NTU over background at the point of discharge. No wet or curing concrete, including washout of equipment, shall enter adjacent waters; forms will remain intact until concrete has cured for at least 72 hours (WSDOT 2010a, p. 2-38). All water coming into contact with uncured concrete shall be tested and treated prior to discharge.

The project will conduct as many as six separate maintenance dredge operations between winter 2012 and spring 2014, in order to maintain the launch channel configuration and ensure sufficient depth for vessel operations and “float-out” of finished pontoons. Each maintenance dredge operation will be smaller and of shorter duration than the initial dredge operation (approximately 13,000-25,000 cy and 15 working days) (WSDOT 2010a, p. 2-5, 6-4). Otherwise, maintenance dredge operations will use the same methods and BMPs as the initial dredge operation, including timing (June 16 through February 28), surface water quality monitoring, and testing and disposal of all dredged/excavated material according to DMMP protocols and standards.

After completion of the planned six cycles of pontoon construction (late spring 2014), the casting basin will be prepared for a period of dormancy. The casting basin and launch channel may be used at some future date to produce additional floating bridge pontoons, but until that time will be maintained in a dry state, with the gate closed, and with stormwater and passive groundwater systems still operational (WSDOT 2010a, pp. 2-16, 2-22). The WSDOT and FHWA may choose to more completely decommission the facility, especially if the site is not chosen for production of additional pontoons as part of the “SR 520 Interstate-5 to Medina Bridge Replacement and HOV Project”, but no decision will be made in this respect until a later date. Any future use of the casting basin (i.e., uses beyond the planned six cycles of pontoon construction concluding late spring 2014) would be subject to its own environmental permit and approval process, including (as necessary) independent section 7 consultation (Bloch, Pers Comm, 2010ab).

Production of Floating Bridge Pontoons

The casting basin will be used to construct approximately thirty-three floating bridge pontoons in six cycles between winter 2012 and spring 2014. Each production cycle will include activities conducted in complete isolation from adjacent waters (i.e., forming, pouring, and curing of concrete pontoons behind a closed casting basin gate), but will also include activities in direct contact with adjacent waters (i.e., gate and vessel operations, flooding of the casting basin, and float-out of finished pontoons). The casting basin and gate have been designed with attention to reducing the risk of entraining fish life, and will implement an approved Fish Handling Plan to ensure the best possible conditions (and least stress or injury) for fish that may be entrained, captured, and handled prior to release (WSDOT 2010a, pp. 2-26, 2-27).
Each pontoon production cycle will have a duration of approximately 6 months. All forming, pouring, and curing will be isolated from adjacent waters, and all process and curing water will be treated prior to discharge. At completion of each cycle, the finished pontoons, casting basin floor, and walls will be mechanically swept and rinsed with clean water (WSDOT 2010a, p. 2-22). Capture and treatment of this water will prevent the release of deleterious materials when flooding the casting basin.

The casting basin design includes a passive system for flooding and floating the finished pontoons behind a closed gate. The intake structure(s) are designed to control velocity and prevent fish entrainment; intakes will comply with standards outlined by the National Marine Fisheries Service (NMFS 1997). Once flooding of the basin is complete, a process requiring 6 hours or longer, launching and float-out of the finished pontoons will be accomplished with the use of pontoons operating within the constructed launch channel. The casting basin gate will remain in an open position for 10 to 12 hours.

After each cycle of finished pontoons has been floated and transported to the off-site moorage location (or to existing port facilities for inspection), the WSDOT and FHWA will implement the approved Fish Handling Plan while dewatering the casting basin in a controlled manner. Water pumped from the casting basin will pass through screened intakes, and the casting basin design includes a power crowder and fish-handling boxes to facilitate safe capture, handling, and release of any entrained fish. A qualified biologist will supervise implementation of the Fish Handling Plan in a manner that minimizes handling and other sources of stress (WSDOT 2010a, pp. 2-26, 2-27).

Moorage and Transport of Bridge Pontoons

Finished pontoons will be transported along established shipping routes. Immediately upon float-out, most pontoons will be transported to existing port/industrial facilities (Port of Grays Harbor Terminals T1-T4) for inspection and final preparation for moorage, including outfitting with navigational lighting and moorage system hardware.

The open water moorage (or pontoon storage) site and anchoring system were selected with attention to several factors, including navigational needs and requirements, avoiding or minimizing conflicts with commercial and recreational fishing, and minimizing potential impacts to biological resources (the benthic and infaunal community, submerged vegetation and macroalgae, etc.).

The proposed moorage site is located south of the main Grays Harbor navigational channel, approximately 5 miles (mi) east of the harbor mouth (Figure 2, p. 7). The moorage site is located in waters ranging in depth from 25 to 65 ft, within a dynamic portion of Grays Harbor characterized by relatively high tidal currents, high rates of sediment/sand transport, and little or no well-established aquatic vegetation or macroalgae (WSDOT 2010a, pp. 2-29, 6-8, 6-30, 6-31).
Figure 7. Taut-line pontoon moorage system with plate anchors.

Pontoons will be anchored in rafts of three or four, with a taut-line mooring system and plate anchors (Figure 7). A taut-line mooring system with plate anchors was selected from a range of options because it effectively limits motion of the raft, while also minimizing anchor chain/cable drag and disturbance of the substrate (WSDOT 2010a, pp. 2-29, 6-8, 6-30, 6-31). A vibratory
driver will be used to install each plate anchor between 30 and 60 ft below the substrate, leaving only the anchor chain visible at the surface. Plate anchor installation is an intermittent activity requiring two to four working days for each raft of pontoons (four anchors).

Because finished pontoons may be used either in the event of a catastrophic failure of the existing floating bridge span, or as part of the planned full replacement of the SR 520 floating bridge, it is uncertain how long the project will store individual pontoons (and rafts of pontoons) at the Grays Harbor moorage site. While it is possible that some pontoons (e.g., those completed in later casting cycles) may be stored for a few months, most pontoons will be stored for two or more years. The FHWA does not expect that pontoons will be stored at this location for more than 5 years (WSDOT 2010a, p. 6-29).

The WSDOT and FHWA plan monthly field inspections of the moored pontoon rafts, and have also committed to annual video reconnaissance or dive inspections of the mooring system (anchor chains/ cables) for the purpose of discovering and removing any entrained fishing gear (e.g., drift nets, gill nets). The WSDOT and FHWA will perform the annual inspection after the close of the Grays Harbor tribal and commercial fishing seasons, during December of each year that pontoon rafts remain at moorage (Bloch, Pers Comm, 2010ba). The WSDOT and FHWA will report their observations to the Service within 30 days of inspection, and the plans for removing any entrained fishing gear in a timely manner.

Prior to transporting pontoons from Grays Harbor via open-water shipping routes, some pontoons may be returned to existing port/ industrial facilities (Port of Grays Harbor Terminals T1-T4) for further inspection and voyage preparation. Pontoons placed in storage for more than 6 months will be inspected for marine growth (WSDOT 2010a, pp. 2-32, 2-42). If inspections find significant growth, the project will clean the pontoon(s) to reduce the risk of transporting invasive plants, algae, or invertebrates from Grays Harbor. Methods of invasive species control have not yet been determined, but are likely to include mechanical methods (e.g., power scrubbers and scrapers).

**Outfitting of Bridge Pontoons**

“Outfitting” is a term used here to mean fabrication of modular over-water bridge components (steel work, forming and pouring of concrete, etc.) placed on-top of the finished floating bridge pontoons. Whether used in the event of a catastrophic failure, or as part of the planned full replacement of the existing SR 520 floating bridge, the project will outfit some pontoons (and perhaps many of the pontoons) at existing port/ industrial facilities along the north shore of Grays Harbor (i.e., Port of Grays Harbor Terminals T1-T4). At these existing port/ industrial facilities, pontoon outfitting represents an activity consistent with current, established uses.

In the event of a catastrophic failure, emergency repair of the floating bridge span will include delivery of finished pontoons to Lake Washington and outfitting completed with the use of temporary barges along the current bridge alignment. For additional details regarding emergency repair, see a sub-section that follows (*Emergency Repair of the SR 520 Floating Bridge Span*).
Mitigation

The WSDOT and FHWA propose compensatory mitigation for unavoidable wetland/ buffer and aquatic resource impacts at the Grass Creek site in Grays Harbor. The Grass Creek site is an approximately 65 acre parcel located along the lowermost reaches of Grass Creek, which enters the eastern portion of North Bay (Grays Harbor) approximately halfway between the mouths of the Humptulips and Hoquiam Rivers (Figure 2, p. 7). State Route 109 and a failing tide gate separate the parcel from tide- and mudflats at the mouth of Grass Creek, and the open waters of the “North Bay” of Grays Harbor.

The project proposes to remove the failing tide gate, excavate and remove approximately 2,650 linear ft of existing earthen dike, grade the site to fill borrow ditches and reestablish remnant tide channels and wetland hydrology, and restore the site with native seeding and plantings (WSDOT 2010a, pp. 2-30, 2-31). The project will rehabilitate approximately 35 acres of formerly diked and grazed wetland, improve approximately 5 acres of degraded tidal channel, create more than 0.5 acre of open mudflat, and enhance and preserve an additional 8 acres of estuarine and palustrine wetland (WSDOT 2010a, p. 2-30). The project will satisfy all permits and approvals issued for the proposed mitigation component, including long term monitoring and replacement to ensure the success of wetland plantings.

Much or all of the proposed work will be completed between May and October of 2011 (or 2012). To the fullest extent practicable, excavation and grading of the site will be completed landward of MHHW and/or around tide cycles, so as to minimize the potential for turbidity and sedimentation (WSDOT 2010a, pp. 2-30, 2-31). Capture, handling, or removal of fish from the work area will not be necessary during construction.

Emergency Repair of the SR 520 Floating Bridge Span

In the event of a catastrophic failure of the existing floating bridge span, this action includes emergency repair activities that would rebuild or reestablish the as-built, four-lane configuration along its current alignment. The full scope of these activities would depend on how much of the existing floating span (or how many of the existing pontoons) have been damaged or lost, and is therefore not certain at this time (WSDOT 2010a, p. 6-44).

The finished pontoons will be transported via open-water shipping routes and the Lake Washington Ship Canal (Chittenden Locks to Montlake Cut), a distance of approximately 250 nautical mi. Pontoons will be transported via a “wet-tow”, pulled or pushed directly by a tug boat(s), along the established crabber/ towboat lanes located 7 to 10 mi offshore (WSDOT 2010a, p. 2-32). Upon arrival to Lake Washington, a voyage of approximately 75 hours, pontoons will be staged near the current floating bridge alignment. Because the open-water portion of the voyage may present unsafe sea state conditions during winter months, most pontoons will be transported between April and September.

Emergency repair activities may include removal of damaged pontoons and associated over-water bridge components, preparation of the existing/ undamaged pontoons, fitting and installation of the new floating bridge pontoons, and on-site outfitting to achieve a seamless
union of the over-water bridge components (WSDOT 2010a, pp. 2-33, 2-34). Many of the exact details are dependent upon the extent of damage, and are not known at this time.

Failure of a portion of the existing floating bridge span, and the emergency repair response that would trigger, may require reinitiation of section 7 consultation. The FHWA anticipates the need to reinitiate consultation in the event of a catastrophic failure of the existing floating bridge span (WSDOT 2010a, p. 6-44).

**Conservation Measures**

The submitted BA includes an extensive list of conservation measures directed at avoiding and reducing temporary impacts during construction (WSDOT 2010a, pp. 2-31 through 2-44). The list includes measures specific to project elements and items of work, and is incorporated here by reference.

**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 section 402.02). As such, the action area includes the extent of the physical, biotic, and chemical effects of the action on the environment. For the purposes of this consultation, we have delineated both aquatic and terrestrial action areas, described below.

The terrestrial boundaries of the action area were defined based on the extent of temporary sound and visual disturbance that will result during construction. Temporary increases in sound are expected to have the farthest reaching effects in the terrestrial environment. Our assessment of in-air sound generation and attenuation finds that increased sound levels are likely to exceed ambient in-air sound levels to a distance of approximately 2.4 mi from the location of impact pile driving (ALY site), and to a distance of approximately 1.7 mi from all other locations where work activities will be conducted (Figures 8 and 10). These values represent transmission over “hard” surfaces, such as open water; transmission over “soft” surfaces (e.g., the landscape landward of the ALY and Grass Creek sites) will be substantially reduced.

The aquatic action areas were defined based on the following:

The geographic extent of temporary increases in underwater sound (construction);

The geographic extent of temporary increases in turbidity and sedimentation (construction);

The geographic extent of the open-water shipping route (pontoon transport or delivery); and,

The geographic extent of any potential effects to sediment transport, water quality, or other functions or processes important to maintaining aquatic habitat over time. This includes all potential effects resulting from construction and operation, including moorage.
Temporary increases in underwater sound are expected to have the farthest reaching effects in the aquatic environment during construction. Our assessment of underwater sound transmission loss finds that increased sound levels are likely to exceed ambient sound levels to a distance of 10 mi or more from the location of impact pile driving (ALY site). However, the presence of landforms and shallow bathymetry will limit transmission to the southern portions of Grays Harbor (Figure 8). Our assessment finds that temporary underwater sound resulting from vibratory installation of plate anchors and other activities at the pontoon moorage location will not extend more than approximately 300 ft. As defined here, these boundaries easily encompass the extent of any temporary or long term changes to patterns of sediment transport, water quality, or other functions important to maintaining aquatic habitat over time.

Outfitting of pontoons, when performed at existing port/industrial facilities, represents an activity consistent with current, established uses. No temporary or permanent effects to the environment will extend from these facilities (Port of Grays Harbor Terminals T1-T4) more than a few hundred ft.

![Figure 8. Grays Harbor action area.](image)

In the event of a catastrophic failure of the existing floating bridge span, this action includes delivery of finished pontoons along open-water shipping routes (and the Lake Washington Ship Canal), and emergency repair activities that would rebuild or reestablish the as-built, four-lane configuration along its current alignment. No incremental effects to the physical, biotic, or chemical environment are reasonably foreseeable as a result of pontoon transport along open-water shipping routes (Figure 9). Temporary increases in in-air and underwater sound are expected to have the farthest reaching effects in the Lake Washington action area (Figure 10).
Figure 9. Open-water shipping route.
Figure 10. Lake Washington action area.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analyses in this Biological Opinion rely on four components: (1) the Status of the Species, which evaluates the species' range-wide condition, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

The jeopardy analyses in this Opinion place an emphasis on consideration of the range-wide survival and recovery needs of the species and the role of the action area in the survival and recovery of the species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.
Adverse Modification

This 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 statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analyses in this Opinion rely on four components: action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determinations, the effects of the proposed Federal action on critical habitat are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat: (1) the Status of Critical Habitat, which evaluates the range-wide condition of designated critical habitat for the species in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action to serve its intended recovery role for the species.

The analyses in this Opinion place an emphasis on using the intended range-wide recovery function of critical habitat, and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

STATUS OF THE SPECIES (BULL TROUT)

The rangewide status of the bull trout is provided in Appendix A.

STATUS OF CRITICAL HABITAT (BULL TROUT)

The rangewide status of bull trout critical habitat is provided in Appendix B.
ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR section 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress. We describe here only those portions of the action area where we anticipate measurable effects to listed species, their prey base, or habitat.

Environmental Baseline in the Action Area

This sub-section describes environmental conditions (physical, biotic, and chemical), including habitat limiting factors, in the Grays Harbor portion of the action area. A sub-section that follows provides similar information for the Lake Washington portion of the action area (Status of the Species in the Action Area – Lake Washington). However, because no significant effects to the physical, biotic, or chemical environment are reasonably foreseeable as a result of pontoon transport, and no measurable effects to listed species or their habitats are anticipated, we do not discuss baseline conditions along the open-water shipping routes.

Grays Harbor is a medium-sized estuarine bay, approximately 17 mi long and 12 mi wide, covering at high tide approximately 97 sq mi (Smith and Wenger 2001, p. 91). Orientation is roughly east-west, with a 2 mile-wide western channel opening to the Pacific Ocean. The Chehalis River, which enters at the easternmost extent of Grays Harbor, is the second largest river basin in Washington State. Grays Harbor’s other major tributary is the Humptulips River. The Hoquiam River, Johns River, and several other direct tributaries have far smaller drainage basins (Smith and Wenger 2001, p. 91). All of Grays Harbor’s direct tributaries, and several additional small- and medium-sized tributaries to the lower Chehalis River (e.g., the Wishkah and Wynoochee Rivers), are tidally-influenced along their lower reaches.

Grays Harbor’s estuarine habitats are more intact than many other similar systems in Washington State. Historical losses (as a result of diking, fill, etc.) are estimated at 30 percent (Smith and Wenger 2001, p. 16). However, while some portions are relatively undeveloped (e.g., North Bay), the inner harbor and vicinity of the Cities of Hoquiam and Aberdeen are heavily industrialized (Smith and Wenger 2001, p. 91).

The Chehalis River is more than 115 mi in length and drains an area of approximately 2,200 square miles, making it the second largest river basin in Washington State. Along its tidally-influenced lower 11 mi, the Chehalis River’s side-channel, riparian, and floodplain habitats are in good to excellent condition, and are considered a high priority for conservation (Smith and Wenger 2001, p. 18).

The greater Grays Harbor-Chehalis basin supports large and comparatively healthy populations of Chinook (Oncorhynchus tshawytscha), chum (O. keta), and coho salmon (O. kisutch), steelhead (O. mykiss) and cutthroat (O. clarki clarki) trout (WDFW October 08, 2010). The
lower Chehalis River and Grays Harbor estuary are vital to the health of these populations, as they provide important migratory and transitional habitat for outmigrating juvenile and returning adult salmonids.

Water and sediment quality are important limiting factors for the basin. The basin includes more than 100 impaired river segments, for which the WDOE has established seven Total Maximum Daily Loads (TMDLs) (WDOE 2004, p. 1). In the middle and upper basins these TMDLs address dissolved oxygen and temperature exceedances; in the lower basins they address dioxin and fecal coliform bacteria exceedances. Historical marine and industrial uses focused around the inner harbor, including pulp and paper mills, have been the cause for water quality concerns (and related fish kills) dating as far back as 1928 (Smith and Wenger 2001, p. 92). However, modernized practices and operations appear now to have controlled and greatly reduced commercial and industrial inputs. Sediment evaluations point to localized metal and synthetic organic contaminant concentrations, but it appears that an active sediment transport regime and good flushing prevent widespread chemical contamination (WDOE 1999, p. iii). Nevertheless, sediments show a strong, pervasive wood waste “signature” (WDOE 1999, p. 14), there is system-wide concern regarding persistent dioxin levels (Smith and Wenger 2001, p. 93), and the most recent studies continue to find that some Gray Harbors sample locations exhibit metal (copper and chromium) and organic contaminant concentrations that may be toxic to biological receptors (WDOE and Partridge 2007, pp. 92-96).

Excess sediment delivery is another important limiting factor for the basin (Smith and Wenger 2001, p. 17). The Chehalis River basin delivers immense quantities of sediment to Grays Harbor, and maintenance of the lower Chehalis River-Grays Harbor navigational channel requires dredging and in-water disposal of more than 2.5 million cy of sediment annually (Smith and Wenger 2001, p. 94). While the system exhibits naturally high levels of turbidity and sedimentation at some times of year (WDOE 1993; 1994), dredging and channel maintenance produce turbidity (and the possibility of resuspended sediment contamination) with potential consequences for juvenile fish and eelgrass habitat in particular (Smith and Wenger 2001, p. 94).

Grays Harbor’s estuarine habitats lack large woody material and, at some locations, have been further degraded by the introduction of invasive, non-native species (e.g., *Spartina*) (Smith and Wenger 2001, pp. 92, 98). Both trends have the effect of reducing available cover and forage habitat for young salmonids, with potential consequences for survival rates and growth.

Taken as a whole, the conditions summarized here describe aquatic habitat which is functioning properly for some indicators, but which is not properly functioning for others. However, with respect to most indicators, conditions should be characterized as functioning at risk.

**Status of the Species in the Action Area**

**Grays Harbor and Lower Chehalis River**

Grays Harbor and its tributaries, including the lower Chehalis River, provide important foraging, migrating, and overwintering (FMO) habitat for anadromous subadult and adult bull trout. The
tributaries to Grays Harbor are not believed to support local populations or spawning, but do provide important FMO habitat located outside of the six identified core areas of the Olympic Peninsula Management Unit. The independent tributaries of Grays Harbor and the lower Chehalis River form the southern boundary of the Olympic Peninsula Management Unit (USFWS 2004).

Migratory bull trout use nonnatal watersheds (habitat located outside of their spawning and early rearing habitat) to forage, migrate, and overwinter (Brenkman and Corbett, in litt. 2003a,b in USFWS 2004). Marine waters, including coastal rivers, estuaries, and nearshore waters, provide access to productive foraging areas and to protected overwintering areas. FMO habitat is important to bull trout of the Olympic Peninsula Management Unit for maintaining diversity of life history forms and for providing access to productive foraging areas (USFWS 2004).

Bull trout have been documented in tributaries west of, and including, the Satsop River in the lower Chehalis River basin (Mongillo 1993). Bull trout are reported historically from the Satsop, Wynoochee, Wishkah, and Humptulips Rivers, but not from the Hoquiam River; information to describe presence in the Hoquiam River is considered a research need (USFWS 2004). Bull trout were reported from Grays Harbor surveys conducted between 1966 and 1981 (Jeanes et al. 2003), but not from surveys conducted between 1981 and 2001. In 2002, beach seine surveys specifically targeting bull trout succeeded in locating the species in Grays Harbor (Jeanes et al. 2003).

Current information is inadequate for determining how bull trout in the independent tributaries of the lower Chehalis River and Grays Harbor interact and relate to one another, or to bull trout of other coastal drainages and core areas (USFWS 2004). However, based on proximity to these other coastal drainages, it is reasonable to assume that bull trout foraging and migrating in the action area are most likely from the Quinault, Queets and/or Hoh River core areas.

The Quinault, Queets, and Hoh River core areas support five of the ten distinct bull trout local populations currently identified within the Olympic Peninsula Management Unit. The Quinault, Queets, and Hoh River core areas play a critical role in the conservation and recovery of bull trout, since each core area is vital to maintaining the overall distribution and genetic diversity of bull trout within the Unit (USFWS 2004). For more complete descriptions of the Quinault, Queets, and Hoh River core areas, see Appendix C.

Each of the bull trout life history forms are believed to be represented within the Quinault, Queets, and Hoh River core areas. However, current information is inadequate for determining the status of the local populations, the locations of most of the actual spawning sites, and the extent to which bull trout of these core areas use nonnatal watersheds (USFWS 2004).

Adult and subadult bull trout may occupy these waters at any time of year. However, an estimate of the number of bull trout that forage, migrate, and overwinter in the action area is not available. Given the limited number of reported observations, and because current information suggests that Grays Harbor and its tributaries do not support local populations or spawning, it is reasonable to assume that low numbers of bull trout are likely to forage, migrate, and overwinter in the action area.
Lake Washington

Lake Washington and its tributaries, including the Cedar and Sammamish Rivers, provide FMO habitat for anadromous subadult and adult bull trout. The tributaries to Lake Washington are not believed to support local populations or spawning, but do provide FMO habitat located outside of the eight identified core areas of the Puget Sound Management Unit. Migratory bull trout use nonnatal watersheds (habitat located outside of their spawning and early rearing habitat) to forage, migrate, and overwinter (Brenkman and Corbett, in litt. 2003a,b in USFWS 2004). FMO habitat is important to bull trout of the Puget Sound Management Unit for maintaining diversity of life history forms and for providing access to productive foraging areas (USFWS 2004).

Lake Washington is located outside of the eight bull trout core areas identified within the Puget Sound Management Unit, and the potential for spawning in the Lake Washington basin is believed to be low (USFWS 2004). Based on their proximity to Lake Washington, and the fact that they support robust bull trout populations and/or a significant anadromous component, we expect that subadult and adult bull trout foraging and migrating in the action area are most likely from the Puyallup, Snohomish-Skykomish, and/or Skagit River core areas.

Lake Washington FMO habitat consists of the lower Cedar River (below Cedar Falls), Sammamish River, Lake Washington, Lake Sammamish, Lake Union, the Lake Washington Ship Canal, and all accessible tributaries (USFWS 2004). Population status information and extent of use is poorly understood or known. Subadult and adult sized individuals have been observed infrequently in the lower Cedar River (below Cedar Falls), Carey Creek (a tributary to Upper Issaquah Creek), Lake Washington, and at the Chittenden Locks. No spawning activity or juvenile rearing has been observed and no distinct spawning populations are known to exist in Lake Washington outside of the upper Cedar River above Lake Chester Morse (not accessible to bull trout within Lake Washington).

The potential for spawning in the Lake Washington basin is believed to be low as a majority of accessible habitat is low elevation, below 152 m (500 ft), and thus not expected to have the proper thermal regime to sustain successful spawning. There are, however, some coldwater springs and tributaries that may come close to suitable spawning temperatures and that may provide thermal refuge during warm summer periods. These include Rock Creek (tributary to the Cedar River below Landsburg Diversion) and Coldwater Creek, a tributary to Cottage Lake Creek immediately below Cottage Lake. Coldwater Creek is a major temperature modifier for both Cottage Lake and Big Bear Creeks. Cottage Lake Creek below Coldwater Creek exhibits a much lower temperature profile than any other tributary to Big Bear Creek. High temperatures in Big Bear Creek are moderated by this flow to its confluence with the Sammamish River. Both Coldwater and Rock Creeks are relatively short, 1.6 to 3.2 km (1 to 2 mi) in length, have high quality riparian forest cover, and are formed by springs from glacial outwash deposits.

Upper reaches of Holder and Carey Creeks, the two main branches of Issaquah Creek, have good to excellent habitat conditions and may hold potential for bull trout spawning due to their elevation and aspect. However, despite survey efforts by King County (Berge and Mavros 2001; KCDNRP 2002) no evidence of bull trout spawning or rearing has been found. Holder Creek
drains the eastern slopes of Tiger Mountain, elevation of 914 m (3,000 ft), and the southwestern slopes of South Taylor Mountain. Coho are found in Holder Creek up to an elevation of about 360 m (1,200 ft) and cutthroat trout occur up to 427 m (1,400 ft) in elevation.

Carey Creek originates at an elevation of roughly 700 m (2,300 ft) in a broad saddle on the southeastern slopes of South Taylor Mountain. It is the only stream in the north Lake Washington/Sammamish drainage with a relatively recent char sighting. The single observation of a pair of native char in the fall of 1993 (WDFW 1998) was about 0.8 km (0.5 mi) downstream from an impassable, approximately 12-m (40-ft) high falls, which is at an elevation of approximately 256 m (840 ft). Thus, habitat in which the pair of char was observed was potentially too low for successful spawning.

A number of observations of subadult and adult bull trout have been made in Lake Washington (Berge, Pers Comm, 2003; KCDNRP 2000; Shepard and Dykeman 1977). Connection with the Chester Morse Lake core area (population located in the upper Cedar River) is one-way only, and currently the level of connectivity with other core areas is unknown. Observations of bull trout in the Chittenden Locks suggest migration from other watersheds is likely occurring.

Bull trout were caught in Shilshole Bay and the Chittenden Locks during late spring and early summer in both 2000 and 2001. In 2000, up to eight subadult and adult fish (mean size 370 mm; 14.5 in) were caught between May and July in Shilshole Bay below the locks. These fish were found preying upon juvenile salmon (40 percent of diet) and marine forage fish (60 percent of diet) (Footen 2000; 2003). In 2001, five adult bull trout were captured from areas within the locks and immediately below the locks. One bull trout was captured in the large locks during June, and one adult was captured during May at the head of the ladder in the adult steelhead trap while migrating upstream through the fish ladder. Three adult bull trout were also captured below the tailrace during the peak of juvenile salmon migration on June 18 (Goetz, Pers Comm, 2003).

Aside from spawning, the Lake Washington drainage has potential benefits and challenges to subadult and adult bull trout. Two large lakes with high forage fish availability are dominant parts of the lower watershed and provide significant foraging habitat. However, recent decades have seen development on a large scale, with an attendant decline in the quality of aquatic environments. The Washington State Conservation Commission has provided a good summary of limiting factors for salmonids in the Cedar-Sammamish (Lake Washington) basin (Kerwin 2001). The submitted BA also provides a good, concise summary of Lake Washington conditions and potential limiting factors (WSDOT 2010a, pp. 5-12 through 5-18); those descriptions are incorporated here by reference.

Adult and subadult bull trout may occupy these waters at any time of year. However, an estimate of the number of bull trout that forage, migrate, and overwinter in the action area is not available. Given the limited number of reported observations, and because current information suggests that Lake Washington and its tributaries do not support local populations or spawning, it is reasonable to assume that low numbers of bull trout are likely to forage, migrate, and overwinter in the action area.
Status of Critical Habitat in the Action Area

The Service’s recent final rulemaking revises the previous (2005) bull trout critical habitat designation (50 FR 63898 [October 18, 2010]). This final rule took effect on November 17, 2010. The action area includes marine and freshwater environments providing several of the bull trout critical habitat PCEs.

Grays Harbor

The action area includes portions of Grays Harbor, including nearshore marine environments less than 10 m in depth. The action area surrounding the ALY site in Grays Harbor includes all of the harbor east of Rennie Island, extending east as far as the mouth of the lower Chehalis River. The action area also extends west along the southern shores of Grays Harbor in the direction of the pontoon moorage site and mouth (Figure 8, p. 19). The action area surrounding the pontoon moorage site mostly encompasses deeper portions of the interior waters, but also includes additional habitats along the southern shores. These habitats provide five of the nine PCEs:

(2) Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The nearshore marine and estuarine environments of Grays Harbor provide important migratory and transitional habitat for salmonids, including bull trout. The action area provides access to FMO habitat and a large prey base found throughout the Grays Harbor-Chehalis basin. Throughout much of the action area, these habitats are functioning properly and migration is relatively unimpeded. Within Grays Harbor as a whole, historical losses of estuarine habitat are estimated at just 30 percent (Smith and Wenger 2001, p. 16).

However, while some portions are relatively undeveloped (e.g., North Bay), the inner harbor and vicinity of the ALY site is heavily industrialized, routinely dredged to maintain navigational access, lacks large woody material, and has been degraded by excess sediment loads and the introduction of invasive, non-native species (Smith and Wenger 2001, pp. 91 through 98). Marine and industrial uses focused around the inner harbor have been the cause for water quality concerns. Modernized practices and operations have controlled and greatly reduced commercial and industrial inputs, but localized sediment contamination can still be found. For additional details, see a preceding sub-section (Environmental Baseline in the Action Area).

Within the action area this PCE is functioning, but moderately impaired.

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

The action area provides access to FMO habitat and a large prey base. The greater Grays Harbor-Chehalis basin supports large and comparatively healthy populations of Chinook, chum, and coho salmon, steelhead and cutthroat trout. The marine waters of Grays Harbor also support
Pacific sand lance (*Ammodytes hexapterus*), Pacific herring (*Clupea harengus pallasi*), and smelt (var. spp.). Within the action area this PCE is fully functioning, with little or no significant impairment.

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

Within Grays Harbor as a whole, historical losses of estuarine habitat are estimated at just 30 percent (Smith and Wenger 2001, p. 16). However, while some portions are relatively undeveloped (e.g., North Bay), the inner harbor and vicinity of the ALY site is heavily industrialized, routinely dredged to maintain navigational access, lacks large woody material, and has been degraded by excess sediment loads and the introduction of invasive, non-native species (Smith and Wenger 2001, pp. 91 through 98). For additional details, see a preceding sub-section (*Environmental Baseline in the Action Area*).

Within the action area this PCE is functioning, but moderately impaired. Shoreline modifications (e.g., riprap armor, bulkheads, artificial overwater structure) are most pervasive for that portion of the action area surrounding the ALY site.

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

Within the action area water temperatures vary in response to tide cycles, river discharge, and broad patterns of oceanic upwelling and exchange. The waters within the action area are not listed for temperature exceedances, and temperatures generally fall within the range required by subadult and adult bull trout. Within the action area this PCE is fully functioning, with little or no significant impairment.

(8) *Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.*

Water and sediment quality are important limiting factors for the Grays Harbor-Chehalis basin. The basin includes more than 100 impaired river segments, for which the WDOE has established seven TMDLs (WDOE 2004, p. 1). In the middle and upper basins these TMDLs address dissolved oxygen and temperature exceedances; in the lower basins they address dioxin and fecal coliform bacteria exceedances. Historical marine and industrial uses focused around the inner harbor, including pulp and paper mills, have been the cause for water quality concerns (and related fish kills) dating as far back as 1928 (Smith and Wenger 2001, p. 92). However, modernized practices and operations appear now to have controlled and greatly reduced commercial and industrial inputs. Sediment evaluations point to localized metal and synthetic organic contaminant concentrations, but it appears that an active sediment transport regime and
good flushing prevent widespread chemical contamination (WDOE 1999, p. iii). Nevertheless, sediments show a strong, pervasive wood waste “signature” (WDOE 1999, p. 14), there is system-wide concern regarding persistent dioxin levels (Smith and Wenger 2001, p. 93), and the most recent studies continue to find that some Gray Harbors sample locations exhibit metal (copper and chromium) and organic contaminant concentrations that may be toxic to biological receptors (WDOE and Partridge 2007, pp. 92-96).

Within the action area this PCE is functioning, but moderately impaired.

**Lake Washington**

The action area includes portions of Lake Washington, including nearshore freshwater environments less than 10 m in depth. These habitats provide six of the nine PCEs:

(2) *Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.*

The action area provides important migratory habitat for salmonids, including bull trout. The action area provides access to FMO habitat and a large prey base found throughout the greater Lake Washington basin.

Throughout the action area, these habitats are functioning at risk and migration is impaired as result of extensive shoreline modification and artificial overwater structure. During summer, upper portions of the Lake Washington water column (or epilimnion) frequently exceed the temperature range required by subadult and adult bull trout (WSDOT 2010a, p. 5-16).

Within the action area this PCE is functioning, but moderately impaired.

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

The Lake Washington FMO, including the Cedar River, Sammamish River, and their tributaries, provide significant foraging habitat and a large prey base. However, recent decades have seen development on a large scale, with an attendant decline in the quality and productivity of aquatic environments. Lake Washington FMO also supports nonnative predatory species (large and smallmouth bass) that presumably compete with bull trout for the same resource.

Within the action area this PCE is functioning, but moderately impaired.

(4) *Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.*
Habitats are functioning at risk and exhibit significant impairment as result of extensive shoreline modification and artificial overwater structure. Within the action area this PCE still functions, but is moderately to severely impaired.

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

During summer, upper portions of the Lake Washington water column (or epilimnion) frequently exceed the temperature range required by subadult and adult bull trout (WSDOT 2010a, p. 5-16). However, Lake Washington also provides deep, temperature-stratified waters where bull trout may find thermal refugia at any time of year.

Within the action area this PCE is functioning, but moderately impaired.

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

Lake Washington is listed for exceedances of several water quality parameters, including synthetic organic compounds and persistent toxics (WSDOT 2010a, p. 5-15). During summer, upper portions of the Lake Washington water column (or epilimnion) frequently exceed the temperature range required by subadult and adult bull trout (WSDOT 2010a, p. 5-16). However, Lake Washington also provides deep, temperature-stratified waters where bull trout may find thermal refugia at any time of year.

Within the action area this PCE is functioning, but moderately impaired.

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

Lake Washington FMO supports nonnative predatory species (large and smallmouth bass) that compete with bull trout for the same prey resources. Within the action area this PCE is functioning, but moderately impaired.

**Effects of Past and Contemporaneous Actions**

Grays Harbor’s estuarine habitats are more intact than many other similar systems in Washington State. However, while some portions are relatively undeveloped (e.g., North Bay), the inner harbor and vicinity of the Cities of Hoquiam and Aberdeen are heavily industrialized. While water and sediment quality conditions have improved over recent decades, persistent system-wide dioxin levels and localized areas of significant metal and organic contamination remain.
Grays Harbor supports large and comparatively healthy populations of Chinook, chum, and coho salmon, steelhead and cutthroat trout. However, important salmonid rearing and migration habitats have been degraded as a result of human alteration of the shorelines and mudflats (including routine dredging of the entire navigation channel), inadequate amounts of large woody material and, at some locations, the introduction of invasive, non-native species (e.g., *Spartina*).

Lake Washington and its tributaries present both potential opportunities and challenges to migratory bull trout. Two large lakes with high forage fish availability are dominant parts of the lower watershed and provide significant foraging habitat. However, recent decades have seen development on a large scale, with an attendant decline in the quality of aquatic environments. Perhaps most significant for bull trout utilizing Lake Washington, past and contemporaneous actions have led to significant impairment as result of extensive shoreline modification and artificial overwater structure. These conditions present a threat to the long term viability of the bull trout prey base, and also favor nonnative predatory species that compete with bull trout for the same prey resources.

We have previously issued Opinions and granted incidental take for actions adversely affecting bull trout of the Quinault, Queets, and Hoh core areas. In each case we determined that these actions are not likely to jeopardize the continued existence of the bull trout and will not destroy or adversely modify designated bull trout critical habitat. Nevertheless, the combined effects of these past and contemporaneous Federal actions have resulted in short and long term adverse effects to bull trout and, in some instances, an incremental degradation of the environmental baseline.

**EFFECTS OF THE ACTION**

Regulations implementing the Act define “effects of the action” as “the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline” (50 CFR Section 402.02). This section details the anticipated effects to bull trout from the proposed action.

To describe the potential effects of the action on bull trout and designated bull trout critical habitat, this Opinion applies in explicit terms an approach that seeks to describe first the effects to the physical, biotic, and chemical environment (potential “stressors”); the likelihood, intensity, and duration of exposure; the anticipated response(s) to exposure; and then, the biological relevance of those responses for individual bull trout and the PCEs, respectively. Effects at the level of the individual (or group of individuals) are then translated or assessed for significance to numbers (abundance), reproduction (productivity), and distribution at the scale of the larger population(s). For critical habitat, we describe expected temporary and permanent effects to the PCEs and, relative to the recovery role for the larger Critical Habitat Unit and critical habitat rangewide, whether the affected critical habitat will remain functional or retain the current ability to establish (or reestablish) functioning PCEs.
Complex actions that include multiple project elements and/or project locations have the potential to cause a variety of exposures (or exposure scenarios). The sub-sections that follow refer to some of the previously described project elements and items of work as a means of organizing the discussion of potential stressors, exposures, responses, and effects. Complex actions occurring at multiple locations may affect a variety of habitat types (e.g., “suitable” habitat, “unsuitable” habitat, etc.) and/or bull trout life history stages. Although, for this action, the affected habitats represent non-core FMO habitat in each case, and only subadult and adult bull trout are likely to be exposed to stressors that elicit a response.

If an effect to the physical, biotic, and/or chemical environment (stressor) would occur at a place or time when exposure of an individual(s) is extremely unlikely, those potential exposures and effects are considered discountable. In general, it is more likely that temporary effects (stressors) and potential exposures can be found discountable. It is more difficult to conclude that permanent or long term effects (stressors) will not expose individuals over time.

If exposure is not discountable and an individual(s) may be exposed to a stressor, the intensity and duration of that potential exposure are important considerations. Some low-intensity and/or short-duration exposures may elicit no response in the individual. Other exposures will or may elicit a response(s), and the biological relevance of those responses must be assessed.

A response is biologically relevant if it measurably affects an individual or a PCE. For example, when stressors elicit an avoidance response and/or prevent or discourage free movement or exploitation of preferred habitats, these responses can have significance for the individual (e.g., reduced foraging success or efficiency, delayed migration). Behavioral responses represent a complex interaction with the affected environment. Determining their biological significance or relevance requires that we evaluate the condition and needs of the individual(s), the amount and quality of affected habitat, the duration and intensity of exposure, and the action or presence of other stressors.

Measurable adverse effects to individuals may reach the level of take. Take may result if the exposure and effect significantly disrupts normal or essential behaviors (e.g., feeding, moving, sheltering, migrating, spawning, rearing), if it results in significant sublethal physiological stress with potential consequences for growth or long term survival, or if it causes physical injury (e.g., gill abrasion, barotrauma) or mortality.

The sub-sections that follow discuss sequentially: insignificant and discountable effects (by project element and/or item of work); adverse effects to individuals (by project element and/or item of work); effects to the PCEs of critical habitat; and, a synthesis of effects and responses at the scale of the larger population(s) and Critical Habitat Unit. Some common potential stressors are discussed repeatedly (e.g., excess turbidity and sedimentation, effects to the prey base).
Insignificant and Discountable Effects (Bull Trout)

This sub-section identifies and discusses in some detail those potential exposures and effects that we conclude are extremely unlikely to occur, and are therefore discountable. This section also identifies and discusses those potential exposures and effects that we conclude will not measurably affect individuals or their habitat, and are therefore insignificant.

Upland Construction of the Casting Basin and Associated Infrastructure

With implementation of the proposed conservation measures and permanent design elements, we conclude that this project element and all associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat.

Upland construction will include placement of as many as 2,200 permanent 18- to 24-in diameter steel piles within the excavated footprint of the casting basin floor and work trestle(s). The project will install the piles with the use of both vibratory and impact pile hammers. Noise and vibration resulting from the work may extend into the immediately adjacent waters at levels detectable by fish. However, we do not expect that temporary sound will reach levels likely to cause significant behavioral disruption or physical injury. Any related temporary effects to normal bull trout behaviors (feeding, moving, and sheltering) will not be measurable and are therefore considered insignificant.

Maintenance and Operations

With implementation of the proposed conservation measures and permanent design elements, we conclude that most of the associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. Maintenance dredge operations are an exception, and are discussed in a sub-section that follows (Adverse Effects of the Action).

Process and stormwater discharges originating from the casting basin facility (ALY) will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. The project will provide basic treatment for all stormwater runoff originating from the developed ALY site, and will treat all process water (batch plant process water and curing water) for control of TSS and pH. Stormwater discharges will comply with the aquatic life turbidity criteria within 300 ft, and process water discharges will not exceed 50 NTU over background at the point of discharge. Discharges will be directed to vegetated ditches at the periphery of the site or to new outfalls constructed within the footprint of the launch channel. All water coming into contact with uncured concrete will be tested and treated prior to discharge.

With consideration for the wide, natural range of ambient turbidities that prevail at the site (WDOE 1993; 1994), the amount and quality of affected habitat (i.e., the immediate vicinity of the points of discharge), and the frequency, duration, and intensity of potential exposures, we expect that process and stormwater discharges will have no measurable effect on bull trout individuals, their prey base, or habitat, and are therefore insignificant.
Production of Floating Bridge Pontoons

With implementation of the proposed conservation measures and permanent design elements, we conclude that most of the associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. Fish entrainment and handling are an exception, and are discussed in a sub-section that follows (Adverse Effects of the Action).

Forming, pouring, and curing of concrete pontoons in isolation from adjacent waters (i.e., behind a closed casting basin gate) will result in no measurable effects to the aquatic environment. All process and curing water will be treated prior to discharge. At completion of each casting cycle, the project will mechanically sweep and rinse with clean water the finished pontoons, casting basin floor, and walls to prevent the release of deleterious materials. Bull trout, their prey base, and habitat will not be exposed to any resulting stressors. Related exposures and effects are extremely unlikely, and therefore discountable.

Vessels used to deliver equipment and materials, or to assist in launching finished pontoons at float-out, will operate within the constructed and maintained launch channel. Vessel operations will be timed around tide cycles to ensure adequate clearance of the channel bottom and prevent grounding. With consideration for the wide, natural range of ambient turbidities that prevail at the site (WDOE 1993; 1994), the amount and quality of affected habitat (i.e., the immediate vicinity of the launch channel), and the frequency, duration, and intensity of potential exposures, we expect that temporary increases in turbidity resulting from vessel operations will have no measurable effect on bull trout individuals, their prey base, or habitat, and are therefore insignificant.

Moorage and Transport

With implementation of the proposed conservation measures and permanent design elements, we conclude that this project element and all associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. Temporary, construction-related effects and resulting potential stressors (e.g., temporary increases in underwater sound, and temporary increases in turbidity) will be limited in physical extent and duration. This element’s potential long term effects to the environment (i.e., associated with extended moorage) will not measurably affect individuals or the bull trout prey base. No permanent effects to bull trout habitat will result from this project element or associated items of work.

The selected moorage site and design reduces the potential for impacts to biological resources. The moorage site is located in waters ranging in depth from 25 to 65 ft, within a dynamic portion of Grays Harbor characterized by relatively high tidal currents, high rates of sediment/ sand transport, and little or no well-established aquatic vegetation or macroalgae. A taut-line mooring system with plate anchors will leave only the anchor chain visible at the substrate surface and will minimize anchor chain/ cable drag and disturbance.

Plate anchor installation is an intermittent activity requiring two to four working days for each raft of pontoons. A vibratory driver will be used to install each plate anchor between 30 and 60 ft below the substrate surface. Vibratory drivers produce, on average, underwater peak pressures
that are approximately 17 dB lower than those generated by impact hammers (Nedwell and Edwards 2002). Underwater sound produced by vibratory and impact hammers differs not only in intensity, but also in frequency and impulse energy (i.e., total energy content of the pressure wave). This may explain why no documented fish kills have been associated with the use of vibratory hammers. Most of the sound energy produced by impact hammers is concentrated at frequencies between 100 and 800 Hz, across the range thought to be most harmful to exposed aquatic organisms, while sound energy produced by vibratory hammers is concentrated between 20 and 30 Hz. In addition, sound pressures produced by impact hammers rise much more rapidly than do the sound pressures produced by vibratory hammers (Carlson et al. 2001; Nedwell and Edwards 2002).

We do not expect that plate anchor installation with a vibratory driver will produce sound pressures with a potential to kill or injure exposed bull trout. Furthermore, while bull trout individuals may be exposed to resulting temporary stressors (temporary underwater sound and turbidity), we expect those exposures will be low-intensity, of short duration, and therefore will not measurably affect normal bull trout behaviors (feeding, moving, and sheltering). We conclude that temporary stressors resulting from anchor installation will have no measurable effect on bull trout individuals, their prey base, or habitat, and are therefore insignificant.

The project will store pontoons in moored rafts, individual rafts remaining in moorage for between 6 months and 5 years. Over time, with completion of additional casting cycles and transport of those pontoons to the moorage site, the combined over-water surface area of these rafts may approach 24 acres in total (WSDOT 2010a, pp. 6-30, 6-31). However, little or no shading effect to the seafloor is expected due to limited light penetration to these depths under existing conditions (WSDOT 2010a, p. 6-36).

Extended moorage will alter hydrodynamics at the substrate surface and may cause localized changes in sediment scour and deposition (WSDOT 2010a, p. 6-31). However, the site is already characterized by dynamic patterns of sediment transport, and any resulting effects will be limited in physical extent and duration. We expect that localized changes in sediment scour and deposition will have no measurable effect on the benthic and infaunal community, submerged vegetation and macroalgae, or forage fish community.

Moored rafts may support a biofouling community attractive to fish or other marine life including invertebrates, birds, and mammals (WSDOT 2010a, pp. 6-32 through 6-34). However, because the pontoons will be moored in deep water, we do not expect that bull trout will be strongly attracted or attracted in large numbers, and we do not expect a measurable increase in bull trout predation pressure (or rates of predation).

The WSDOT and FHWA plan monthly field inspections of the moored pontoon rafts, and have also committed to once-annual video reconnaissance or dive inspections of the mooring system (anchor chains/ cables) for the purpose of discovering and removing any entrained fishing gear (e.g., drift nets, gill nets). With implementation of the proposed conservation measures and permanent design elements, we expect that entanglement of bull trout in entrained fishing gear is extremely unlikely and therefore discountable.
We expect that open water moorage at the selected site will have no effect on the free movement or migration of individual bull trout. We expect no measurable, adverse effects to bull trout habitat or the bull trout prey base, and no measurable changes to bull trout foraging efficiency or rates of bull trout predation. Temporary underwater sound and turbidity resulting from construction will be limited in physical extent and duration, will be low-intensity, and therefore will not measurably affect normal bull trout behaviors (feeding, moving, and sheltering). This element’s potential long term effects to the environment (i.e., associated with extended moorage) will not measurably affect individuals or the bull trout prey base, and are therefore insignificant.

This action includes delivery of finished pontoons along open-water shipping routes and the Lake Washington Ship Canal (Chittenden Locks to Montlake Cut) (Figure 9, p. 20). Prior to transporting pontoons from Grays Harbor, the project will inspect the pontoons for marine growth. If inspections find significant growth, the project will clean the pontoon(s) to reduce the risk of transporting invasive plants, algae, or invertebrates from Grays Harbor. The project will pull or push pontoons with tug boats, along the established crabber/towboat lanes 7 to 10 mi offshore.

Pontoon transport will result in temporary noise and vibration, but will otherwise have no incremental long term effects on the physical, biotic, or chemical environment. While bull trout may be exposed to temporary noise and vibration associated with pontoon transport, we do not expect that these intermittent exposures will result in measurable effects to normal bull trout behaviors. And, while we cannot entirely discount the risk of transporting invasive species from Grays Harbor to parts of the Puget Sound, no related measurable effects to bull trout, their prey base, or habitat are foreseeable and reasonably certain to occur.

**Outfitting**

With implementation of the proposed conservation measures and permanent design elements, we conclude that this project element and all associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. Outfitting of pontoons, when performed at existing port/industrial facilities in Grays Harbor, represents an activity consistent with current, established uses. Any measurable, temporary effects to the environment will be limited in physical extent (i.e., extending less than 300 ft) and duration, and will not extend to habitats that are likely to be occupied during the period of construction. No long term or permanent effects to bull trout habitat will result from this project element or associated items of work. All forms of exposure and effect related to this element are extremely unlikely, and therefore discountable.

**Mitigation**

With implementation of the proposed conservation measures and permanent design elements, we conclude that this project element and all associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. Temporary, construction-related effects and resulting potential stressors (e.g., temporary increases in underwater sound,
temporary increases in turbidity) will be limited in physical extent and duration. This element’s long term or permanent effects to the environment will restore habitat and habitat functions, with potential benefits for bull trout and their prey.

The project will remove a failing tide gate, excavate and remove existing earthen dike, fill borrow ditches, reestablish remnant tide channels and wetland hydrology, and restore with native seeding and plantings approximately 43 acres of wetland, 5 acres of tidal channel, and 0.5 acre of open mudflat. Much or all of the proposed work will be completed between May and October, and to the fullest extent practicable, excavation will be completed landward of MHHW and/or around tide cycles. The project does not propose to capture, handle, or remove fish from the work area during construction.

Mitigation activities completed at the Grass Creek site will include removal and control of noxious weeds and invasive plant species with implementation of integrated vegetation and pest management principles. The project will rely on the WSDOT’s Maintenance crews to complete both the initial and follow-up, maintenance treatments. The initial treatment will include both mechanical removal (cutting and/or mowing) and focused application of a non-residual herbicide with low non-target toxicity. The herbicide commonly used is glyphosate, in the form of trademarked products “Rodeo” and/or “Aquamaster”. Herbicide formulations and applications will comply with the herbicide’s Federal Insecticide, Fungicide, and Rodenticide Act label requirements, the NPDES General Permit for Aquatic Noxious Weed Control (State of Washington Department of Ecology Permit No. WAG–993000), and local noxious weed requirements, including as these pertain to schedule, notification, monitoring, and compliance. After weeds and invasive species are nearly or completely eradicated from the site, and native wetland plantings and seed have been successfully established, maintenance treatments will address any remaining problem locations on a case-by-case basis.

We expect that the proposed herbicide treatments at the Grass Creek site will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. Glyphosate formulations exhibit low non-target toxicity, typically bind well to soils and sediment and therefore have low potential for leaching, readily breakdown and/or become inactivated by microbial degradation under varying field conditions, and exhibit no tendency toward bioaccumulation in the food chain (CDPR and Schuette 1998; USEPA 1993; 2002). Kubena (1998) found no biologically relevant responses (behavioral or physiological), except when juvenile salmonids were exposed to grossly exaggerated concentrations (e.g., 1000 times or greater than likely “real-world” concentrations). Simenstad and Feist (1996) found no significant short or long term effects on estuarine invertebrates where field studies have investigated glyphosate applications around Willapa Bay, Washington.

Temporary, construction-related effects and resulting potential stressors will be limited in physical extent and duration. Given the amount and quality of affected habitat, and with consideration for the timing, methods, and duration of construction, we conclude that exposure of bull trout individuals to construction activities is extremely unlikely and therefore discountable. With implementation of the proposed conservation measures, including full compliance with the above-mentioned requirements, we conclude that herbicide treatments at the Grass Creek site will have no measurable, adverse effects on bull trout individuals, their prey
base, or habitat. This element’s long term or permanent effects to the environment will restore habitat and habitat functions, with potential benefits for bull trout and their prey.

**Emergency Repair of the SR 520 Floating Bridge Span**

With implementation of the proposed conservation measures and permanent design elements, we conclude that this project element and all associated items of work will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat. Temporary, construction-related effects and resulting potential stressors (e.g., temporary increases in underwater sound, temporary increases in turbidity) will be limited in physical extent and duration. This element’s potential long term effects to the environment (i.e., associated with extended over-water construction activities) will not measurably affect individuals. No permanent effects to bull trout habitat will result from this project element or associated items of work.

In the event of a catastrophic failure of the existing floating bridge span, this action includes emergency repair activities that would rebuild or reestablish the as-built, four-lane configuration along its current alignment. The project will transport finished pontoons via open-water shipping routes and the Lake Washington Ship Canal (Chittenden Locks to Montlake Cut). Upon arrival to Lake Washington, pontoons will be staged near the current floating bridge alignment. Repair activities would include removal of damaged pontoons, preparation of the existing/undamaged pontoons, fitting and installation of the new pontoons, and on-site outfitting to achieve a seamless union of the over-water bridge components. Repair activities do not include installation of piles or anchors with an impact hammer or work area isolation (and related capture, handling, and removal of fish). Most or all of this work would be completed with the use of temporary barges located in deep (10 to 60 m) water.

We expect that this project element and all associated items of work will have no effect on the free movement or migration of individual bull trout. Temporary underwater sound and turbidity resulting from construction will be limited in physical extent and duration, will be low-intensity, and therefore will not measurably affect normal bull trout behaviors (feeding, moving, and sheltering). We expect no measurable, temporary or permanent adverse effects to bull trout habitat or the bull trout prey base. This project element’s potential effects are therefore considered insignificant.

**Adverse Effects of the Action (Bull Trout)**

While we expect that several of the included project elements, and many associated items of work, will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat, we do nevertheless expect that measurable, adverse effects will result from the proposed project. In-water construction and maintenance of the casting basin launch channel at the ALY site includes construction activities we expect will result in measurable, adverse effects to bull trout and their habitat. These activities include clamshell dredging and removal of wood piles from the launch channel footprint, placement of permanent riprap armor along the launch channel side-slopes, installation of permanent steel and wood piles by a combination of vibratory and impact pile driving methods, and a program of maintenance dredge operations designed to maintain the launch channel configuration over time. We also expect that additional adverse
effects will result from fish entrainment and handling within the ALY casting basin during the anticipated six cycles of pontoon construction.

Construction activities conducted below MHHW at the ALY site will produce stressors with potential adverse effects to bull trout, their prey base, and habitat. These stressors include temporary increases in underwater sound resulting from impact pile driving, and effects to water quality (turbidity, dissolved oxygen, and low-level contamination) resulting from dredge operations. These stressors have the potential to kill or injure a limited number of subadult and adult bull trout. Temporary exposures may also significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). These exposures may temporarily cause bull trout to avoid the action area, may impede or discourage free movement through the action area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the proposed action will have no effect on bull trout rearing or spawning habitat, or these essential behaviors.

Features included in the launch channel design (i.e., the launch channel footprint, side-slope armor, permanent piling, and associated infrastructure) will result in permanent and temporary adverse effects to bull trout habitat structure, function, and diversity. These permanent and temporary adverse effects will significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter).

Although the ALY casting basin, gate, and operating procedures have been designed to minimize the risk of entraining fish life, we cannot rule out the possibility that a limited number of subadult and adult bull trout may become entrained during the anticipated six cycles of pontoon construction. The proposed operating procedures, including implementation of an approved Fish Handling Plan, will minimize, but not completely avoid, the stress and potential for injury resulting from entrainment, capture, and handling prior to release.

The sub-sections that follow discuss these project elements and activities, resulting stressors, exposures, and adverse effects in greater detail.

Exposures and Effects Resulting from Fish Entrainment, Capture, and Handling

The project will use the casting basin and launch channel to construct floating bridge pontoons in six cycles between winter 2012 and spring 2014. Each production cycle will include some activities conducted in complete isolation from adjacent waters, such as the forming, pouring, and curing of concrete pontoons behind a closed casting basin gate. Other activities will result in direct contact with adjacent waters, such as gate operations, flooding of the casting basin, and float-out of finished pontoons. The casting basin and gate have been designed with attention to reducing the risk of entraining fish life, and the project will implement an approved Fish Handling Plan to ensure the best possible conditions (and least stress or injury) for fish that may be entrained, captured, and handled prior to release.

Although the ALY casting basin, gate, and operating procedures have been designed to reduce the risk of entraining fish life, we cannot rule out the possibility that a limited number of
subadult and adult bull trout may become entrained during the anticipated six cycles of pontoon construction. The risk of entrainment will be greatest on those occasions when gate openings occur outside of the in-water work window. The planned schedule will necessitate gate openings outside of the in-water work window (June 16 through February 28) on at least two occasions (WSDOT 2010a, p. 2-35). The proposed operating procedures will minimize, but not completely avoid, the stress and potential for injury resulting from entrainment, capture, and handling prior to release. We expect that adverse effects to individual bull trout will result from fish entrainment and handling within the ALY casting basin.

Sublethal Physiological Stress Resulting from Fish Handling

Studies investigating acute, sublethal physiological stress in captured and handled salmonids consistently document induced changes in blood chemistry (e.g., cortisol, corticosteroid, and blood sugar levels; lymphocyte numbers) (Barton and Iwama 1991, p. 3; Frisch and Anderson 2000, p. 23; Hemre and Krogdahl 1996, p. 249; Pickering et al. 1982, p. 229; Wydoski et al. 1976, p. 602). Even short and mild bouts of handling have been shown to induce protracted changes, lasting hours or days (Frisch and Anderson 2000, p. 23; Hemre and Krogdahl 1996, p. 249; Wydoski et al. 1976, p. 604). Pickering et al. (1982, p. 229) reports that the time course for recovery of individual parameters suggests a minimum 2-week period for full recovery, and return to normality.

Stress induced effects to blood chemistry may have consequences for metabolic scope, reproduction (i.e., altered patterns or levels of reproductive hormones), and immune system function or capability (Barton and Iwama 1991, p. 3; Frisch and Anderson 2000, p. 29; Pickering et al. 1982, p. 229). Pickering et al. (1982, p. 231) reports a marked reduction in feeding activity lasting three days after handling. Barton and Iwama (1991, p. 3) and Frisch and Anderson (2000, p. 23) both point to the possibility of increased disease susceptibility attributable to handling related physiological stress.

While few if any studies have tracked long term consequences for growth, survival, or reproductive success, there is strong evidence to suggest a causal link between fish handling stress and altered salmonid physiological function. Furthermore, these stress induced changes to physiology are, in and of themselves, relevant indicators for potential effects to growth, survival, and reproduction.

Estimate of the Extent of Effect

Adult and subadult bull trout may occupy the waters immediately surrounding the ALY launch channel at any time of year. However, data to estimate the number of bull trout that may forage, migrate, and overwinter in this portion of the action area are not available.

The casting basin design includes a passive system for flooding and floating the finished pontoons behind a closed gate. The intake structure(s) are designed to control velocity and prevent fish entrainment; intakes will comply with standards outlined by the National Marine Fisheries Service (NMFS 1997). Once flooding of the basin is complete, the casting basin gate will be removed to allow for launching and float-out of the finished pontoons.
The approximately eight ac casting basin will remain open to the adjacent waters for 10 to 12 hours each cycle. After float-out is complete, the WSDOT and FHWA will place the casting basin gate back into position and begin dewatering or “draw-down” of the basin with the use of screened pumps. Complete dewatering will require 12 to 15 hours and any entrained fish will remain within the basin until it is drawn down to a depth of 24 to 30 inches (WSDOT 2010a, pp. 2-25, 2-26).

Once water within the basin has been drawn down to a depth of 24 to 30 inches, a qualified biologist will supervise implementation of the Fish Handling Plan in a manner that minimizes handling and other sources of stress. Operating procedures will include the use of a power crowder, additional manual crowders, fish-handling boxes, and an aeration system(s) (WSDOT 2010a, pp. 2-25 through 2-27).

With consideration for the amount and quality of adjacent habitat and the duration of direct contact with adjacent waters, variability in the risk of entrainment at different times of the year, and because we expect that bull trout occur in Grays Harbor in only very low numbers, we do not expect that bull trout will be entrained within the casting basin during each cycle. However, over the course of six cycles of pontoon construction, we do expect that at least four individual subadult or adult bull trout may become entrained. With implementation of the approved Fish Handling Plan and all related operational procedures, we expect that no more than one subadult or adult bull trout will suffer physical injury or mortality, and no more than three subadult or adult bull trout will experience stress not reaching the level of physical injury, during the course of six cycles of pontoon construction (between winter 2012 and spring 2014). We do not expect that fish entrainment, capture, and handling at the ALY casting basin will have a measurable effect on the bull trout’s available prey base. Related effects to the bull trout prey base will be insignificant.

Exposure to Elevated Turbidity and Degraded Water Quality

Construction and maintenance of the casting basin launch channel at the ALY site includes activities we expect will temporarily degrade water quality and result in measurable, adverse effects to bull trout and their habitat. These activities include clamshell dredging and removal of wood piles from the launch channel footprint during the initial dredge operation, and maintenance dredge operations designed to maintain the launch channel configuration for the duration of the planned six cycles of pontoon construction.

The proposed launch channel would extend approximately 430 ft, from the existing shoreline (or MHHW) to the lower Chehalis River/Grays Harbor navigation channel (Figure 6, p. 10). Construction of the launch channel will require an initial dredge operation removing approximately 87,000 cy (approximately 60 working days, 2011-2012), and removal of approximately 32 wood piles with the use of a vibratory hammer or by direct pulling. The project will also conduct as many as six separate maintenance dredge operations between winter 2012 and spring 2014, in order to maintain the launch channel configuration and ensure sufficient depth for vessel operations. Maintenance dredge operations will be smaller and of shorter duration than the initial dredge operation (approximately 13,000 to 25,000 cy and 15
working days) (WSDOT 2010a, p. 2-5, 6-4). All dredge operations will be completed during the in-water work window (June 16 through February 28).

Dredging operations will use an environmental clamshell bucket operating from barges, except where site conditions or obstructions require use of a conventional bucket. The project will implement BMPs to minimize release of sediment to the surrounding waters, monitor for compliance with aquatic life turbidity criteria at the edge of the allowable mixing-zone (300 ft), and will properly contain, test, transport, and dispose of all dredged/ excavated material according to DMMP protocols and standards. Authorized use of the DMMP open-water disposal site(s) near the mouth of Grays Harbor is an interrelated action, but one that is subject to independent section 7 consultation (FWS Ref. No. 1-3-06-I-0469). At completion of the initial dredge operation, the project will perform sample analyses to confirm that surficial sediments meet sediment quality standards.

We expect that the initial dredge operation, and the program of maintenance dredge operations to follow, will temporarily degrade water quality and thereby result in measurable, adverse effects to bull trout and their habitat. Dredge operations will produce temporary stressors, including conditions of high turbidity, low dissolved oxygen, and potential low-level contamination. Construction and maintenance of the launch channel will also result in permanent and temporary adverse effects to bull trout habitat structure, function, and diversity; see a sub-section that follows (Permanent and Temporary Effects to Habitat).

We do not expect that individuals will be injured or killed as a result of entrainment or direct physical contact with the dredge device. Injury or mortality resulting from direct contact is extremely unlikely, and therefore discountable. However, we do expect that resulting temporary stressors will be intense closest to the operations, and exposed individuals may suffer significant, sub-lethal physiological stress.

Temporary water quality stressors resulting from dredge operations will significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). Dredge operations may cause bull trout to temporarily avoid the area, may impede or discourage free movement through the area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.

Dredge Operations

Past dredge operations conducted along the lower Chehalis River/ Grays Harbor navigation channel have produced extremes of turbidity and other indications of temporary water quality impairment (Smith and Phipps 1983; Smith et al. 1975, pp. vi-viii; Phipps et al. 1992 in USACE 2006, pp. 12-14). Inner harbor dredge operations, where the sediments are fine-grained and methods rely on a clamshell dredge, have produced the highest turbidities (Phipps et al. 1992 in USACE 2006, pp. 12-14). Phipps et al. (1992 in USACE 2006, pp. 12-14) report temporary TSS concentrations in excess of 500 mg/L occurring with some regularity, and extremes as high as 3,000 mg/L, typically at lower depths within the water column.

When suspended in the water column, dredged anaerobic sediments and woody debris can increase biological oxygen demand (Hicks et al. 1991 in WSDOT 2010a, p. H-18)(Morton 1976

When released during the course of dredging, dredged sediments, woody debris, and pore water may also introduce sediment contamination to the surrounding water column. While sediments from the dredge prism have been assessed and found suitable for unconfined open water disposal at authorized DMMP disposal sites, these sediments do contain low-level metal, dioxin, and synthetic organic contamination (including hydrocarbons, phthalates, pesticides, and polychlorinated biphenyls or PCBs) (WSDOT 2010bb, pp. 4-3, 4-4).

**Temporary Water Quality Stressors**

Although few studies have specifically examined the issue as it relates to bull trout, increases in suspended sediment affect salmonids in several recognizable ways. The effects of suspended sediment may be characterized as lethal, sublethal or behavioral (Bash et al. 2001; Newcombe and MacDonald 1991; Waters 1995). Lethal effects include gill trauma (physical damage to the respiratory structures), severely reduced respiratory function and performance, and smothering and other effects that can reduce egg-to-fry survival (Bash et al. 2001). Sublethal effects include physiological stress reducing the ability of fish to perform vital functions (Cederholm and Reid 1987), increased metabolic oxygen demand and susceptibility to disease and other stressors (Bash et al. 2001), and reduced feeding efficiency (Bash et al. 2001; Berg and Northcote 1985; Waters 1995). Sublethal effects can act separately or cumulatively to reduce growth rates and increase fish mortality over time.

Exposure concentration and duration will strongly influence whether temporary exposures cause lethal or sublethal effects. Information is limited and there are important sources of uncertainty. These sources of uncertainty include grain size, the quantity and composition of resuspended sediment, the quantity and composition of released interstitial pore water, and the rate or degree of contaminant desorption to the surrounding water column. Additional sources of uncertainty include the effect of intermittent, episodic, or transient exposures (Burton et al. 2000, p. ab; Marsalek et al. 1999, p. 34), variations in tolerance among exposed individuals, populations, and/or species (Ellis 2000, p. 89; Hodson 1988, p. ab; Lloyd 1987, p. 502), and, the potential for additive or synergistic effects among water quality stressors (Burton et al. 2000, p. ab; Ellis 2000, p. 88; Lloyd 1987, p. 494). Burton et al. (2000, p. ab) have emphasized the importance of “real-world” patterns of exposure. Lloyd (1987, pp. 492, 501) suggests that water quality stressors can exert a greater effect when dissolved oxygen levels are low.

Behavioral effects include avoidance, loss of territoriality, and related secondary effects to feeding rates and efficiency (Bash et al. 2001). Fish may be forced to abandon preferred habitats and refugia, and may enter less favorable conditions and/or be exposed to additional hazards (including predators) when seeking to avoid elevated TSS concentrations. Hicks (1999 in WSDOT 2010a, p. H-18) reports avoidance behavior in salmonids responding to dissolved oxygen levels below 5.5 mg/L.
Estimate of the Extent of Effect

Adult and subadult bull trout may occupy the waters immediately surrounding the ALY launch channel at any time of year. However, data to estimate the number of bull trout that may forage, migrate, and overwinter in this portion of the action area are not available.

We used the analytical framework attached as Appendix D to assess TSS concentrations at which adverse effects will occur, and to determine the downstream extent of these effects. This framework uses the findings of Newcombe and Jensen (1996) to evaluate the “severity-of-effect” (SEV) based on TSS concentration, exposure, and duration. Factors influencing concentration, exposure, and duration include waterbody size, volume of flow, the nature of the construction activity, construction methods, erosion controls, and substrate and sediment particle size. Factors influencing the SEV include duration and frequency of exposure, concentration, and life stage. Availability and access to refugia are other important considerations.

The framework in Appendix D requires an estimate of suspended sediment concentration (mg/L) and exposure duration. In the absence of any reliable, large datasets with which to determine the ratio of turbidity to suspended solids for this portion of Grays Harbor, we instead relied on a large dataset available for the lower Chehalis River near Montesano, Washington. Monitoring data collected at the WDOE station on the Chehalis River (WDOE 2010) were used to determine the ratio of turbidity to suspended solids (1 NTU : 2.52 mg/L).

To determine exposure duration, we assumed that the initial dredge operation would occur 10 hours a day, for as many as 60 working days, between June 16, 2011, and February 28, 2112. We assumed that each maintenance dredge operation would occur 10 hours a day, for as many as 15 working days, between June 16 and February 28 (2012-2014). It is important to note, we expect that any measurable water quality impairment will be short term and episodic.

Using this approach, we expect that adverse effects to subadult and adult bull trout are likely to occur under the following circumstances:

1. When background NTU levels are exceeded by 160 NTUs at any point in time.
2. When background NTU levels are exceeded by 60 NTUs for more than 1 hour, continuously, over a 10-hour workday.
3. When background NTU levels are exceeded by 22 NTUs for more than 7 hours, cumulatively, over a 10-hour workday.
4. When background NTU levels are exceeded by 8 NTUs for durations approaching 2 days (24 hours), continuously.

A number of site-specific conditions will influence the spatial extent of potential water quality exposures. Acute exposures are usually most intense in the initial mixing zone where sediment resuspension creates a three-dimensional plume that dissipates vertically, horizontally, and longitudinally (Bridges et al. 2008, pp. 6-8, 15, 18). The size and shape of the temporary plume,
and therefore the spatial extent of potential exposures, will be influenced by the following: the quantity and composition of resuspended sediment, the quantity and composition of released interstitial pore water, the rate or degree of desorption to the surrounding water column, particle size and resettling rate, discharge volume, current, tidal flux, degree of turbulence, height of release to the water column, shear stress at the channel bottom, water temperature and salinity, and operational considerations (Bridges et al. 2008, pp. 5, 7-9, 13, 20, 42). Empirical evidence suggests that plumes resulting from dredging generally transition from “near field zone” processes (including potential acute exposures), to “far-field zone” processes within 100 m of the operation (Bridges et al. 2008, p. 7).

For adult salmonids, an SEV value of 9 or greater is associated with potential physical injury (Appendix D). If subadult and adult bull trout are exposed to extremes of turbidity approaching 3,000 mg/L for a duration exceeding 3 hours, they are likely to suffer physical injury (Appendix D, Figure 2, p. 17). Based on the nature of the proposed work, and with implementation of the proposed conservation measures, we expect that acute water quality exposures with the potential to injure or kill subadult and adult bull trout will be confined to within 300 ft of the ongoing dredge operation. However, we also conclude that bull trout would likely avoid these levels of turbidity, and it is extremely unlikely that any individual bull trout would be exposed to the ongoing work for an extended duration of time. Therefore, exposures with the potential to kill or injure are considered discountable.

We expect that less severe, but still measurable effects to water quality will extend a greater distance from the ongoing dredge operation, and will thereby significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). Dredge operations and resulting water quality stressors may cause bull trout within 750 ft to temporarily avoid the area, will impede or discourage free movement through the area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.

With full implementation of the agreed upon conservation measures, we expect that temporary, degraded water quality conditions will significantly disrupt the normal behaviors of a small number of subadult and adult bull trout. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore dredge operations will have no effect on bull trout rearing and spawning habitat or these essential behaviors.

**Exposure to Elevated Underwater Sound Pressure Levels**

While constructing the ALY casting basin launch channel and associated infrastructure, the project will install approximately 70 permanent steel and wood piles below the MHHW. All piles placed below the MHHW will be installed with a vibratory hammer to the fullest extent practicable. If site conditions require the use of an impact pile hammer, the project will implement a sound attenuation system (i.e., bubble curtain) and underwater sound monitoring plan.

Pile driving and proofing with an impact hammer has the potential to kill or injure a limited number of subadult and adult bull trout. Elevated underwater sound pressure levels (SPLs) resulting from pile driving and proofing with an impact hammer may also significantly disrupt
normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). Pile driving and proofing with an impact hammer may cause bull trout to temporarily avoid the area, may impede or discourage free movement through the area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.

We do not expect that underwater sound produced when installing piles with a vibratory hammer will measurably affect normal bull trout behaviors. Vibratory drivers produce, on average, underwater peak pressures that are approximately 17 dB lower than those generated by impact hammers (Nedwell and Edwards 2002). Underwater sound produced by vibratory and impact hammers differs not only in intensity, but also in frequency and impulse energy (i.e., total energy content of the pressure wave). This may explain why no documented fish kills have been associated with the use of vibratory hammers. Most of the sound energy produced by impact hammers is concentrated at frequencies between 100 and 800 Hz, across the range thought to be most harmful to exposed aquatic organisms, while sound energy produced by vibratory hammers is concentrated between 20 and 30 Hz. In addition, sound pressures produced by impact hammers rise much more rapidly than do the sound pressures produced by vibratory hammers (Carlson et al. 2001; Nedwell and Edwards 2002). We expect that underwater sound produced when installing piles with a vibratory hammer will not be detectable to a significant distance and that bull trout present within the action area will not be measurably affected.

Effects of Elevated Underwater SPLs - General

High underwater SPLs are known to have negative physiological and neurological effects on a wide variety of vertebrate species (Hastings and Popper 2005; Turnpenny and Nedwell 1994; Yelverton et al. 1973; Yelverton and Richmond 1981). High underwater SPLs are known to injure and/or kill fishes, as well as cause temporary stunning and alterations in behavior (Hastings and Popper 2005; Popper 2003; Turnpenny and Nedwell 1994; Turnpenny et al. 1994).

Risk of injury appears related to the effect of rapid pressure changes, especially on gas-filled spaces in the bodies of exposed organisms (Turnpenny et al. 1994). Fish-kills have been among the most noticeable and well-documented adverse effects of in-water impact pile driving. With few exceptions, however, fish-kills are generally reported only when dead or injured fish are observed at the surface and therefore the frequency and magnitude of such kills are likely underestimated. High underwater SPLs can also cause a variety of behavioral responses, many of which have not been thoroughly studied.

The effects of elevated underwater SPLs on exposed organisms can vary substantially, ranging broadly from no noticeable effect to instantaneous mortality. Over this continuum of effect, there is no easily identifiable point at which behavioral responses transition to physical effects. We evaluated two types of exposure to elevated SPLs, those causing injury and/or mortality, and those causing significant behavioral responses or disruption.
Effects of Elevated Underwater SPLs - Injury and Mortality

Injury and mortality in fishes has been attributed to impact pile driving (Abbott et al. 2005; Hastings and Popper 2005; Stadler, Pers Comm, 2002; Stotz and Colby 2001). The injuries associated with exposure to high SPLs are referred to as barotraumas, and include hemorrhage and rupture of internal organs, hemorrhaged eyes, and temporary stunning (Hastings and Popper 2005; Turpenny and Nedwell 1994; Yelverton et al. 1973; Yelverton et al. 1975; Yelverton and Richmond 1981). Death as a result of barotrauma can be instantaneous, occurring within minutes after exposure, or can occur several days later (Abbott et al. 2002). Necropsy results from Sacramento blackfish (Othodon microlepidotus) exposed to high SPLs showed fish with extensive internal bleeding and a ruptured heart chamber were still capable of swimming for several hours before death (Abbott et al. 2002). Sublethal injuries can interfere with the ability to carry out essential life functions such as feeding and predator avoidance (Popper 2003).

The potential for injury and/or mortality depends on several factors, including the type of sound and intensity of sound produced. These, in turn, are strongly influenced by the type of hammer, characteristics of the substrate and subsurface conditions, depth of water, and the presence or absence of channel (bed and bank) formations that might serve to naturally intercept and attenuate SPLs. Firmer substrates are more resistant to penetration, generally require more force and energy when pile driving, and therefore usually produce more intense sound pressures. In addition to the type of sound and intensity of sound produced, other factors that influence the potential for injury and/or mortality include the size of the exposed organism(s), anatomical variation, and location in the water column (Gisiner et al. 1998). Sound energy from an underwater source readily enters the bodies of exposed organisms because the acoustic impedance of animal tissue nearly matches that of water (Hastings 2002).

Gas-filled structures are particularly susceptible to the adverse effects of elevated underwater sound (Gisiner et al. 1998). Examples of gas-filled structures found in vertebrate species include swimbladders, bowels, sinuses, and lungs. As sound travels from a fluid medium into a gas-filled structure there is a dramatic drop in pressure, which can cause rupture of the hollow organs (Gisiner et al. 1998). This has been demonstrated in fishes with swimbladders (including salmonids). As a sound pressure wave passes through a fish, the swimbladder is rapidly compressed due to the high pressure and then rapidly expanded by the underpressure. Exposure to this type of “pneumatic pounding” can cause rupture of capillaries in the internal organs, as observed in fishes with blood in the abdominal cavity, and maceration of kidney tissues (Abbott et al. 2002; Stadler, Pers Comm, 2002).

Yelverton and Richmond (1981) and Yelverton et al. (1973) exposed a variety of fish species, various birds, and terrestrial mammals to underwater explosions. Common to all the species were injuries to air- and gas-filled organs, as well as eardrums. These studies identified injury thresholds in relation to the size of the charge, the distance at which the charge was detonated, and the mass of the exposed animal. Yelverton et al. (1973) and Yelverton and Richmond (1981) found that the greater the fish’s mass, the greater impulse level needed to cause an injury. Conversely, a fish with smaller mass would sustain injury from a smaller impulse.
At Bremerton, Washington, approximately 100 surfperch (Cymatogaster aggregata, Brachyistius frenatus and Embiotoca lateralis) were killed during impact driving of 30-inch diameter steel pilings (Stadler, Pers Comm, 2002). The size of these fish ranged from 70 mm to 175 mm fork length. Dissections revealed that the swimbladders of the smallest of the fishes (80 mm fork length) were completely destroyed, while those of the largest individual (170 mm fork length) were nearly intact. Damage to the swimbladder of C. aggregata was more severe than to similar-sized B. frenatus. These results are suggestive of size and species-specific differences and are consistent with those of Yelverton et al. (1975) who found size and/or species differences in injury from underwater explosions.

Another mechanism of injury and mortality resulting from high SPLs is “rectified diffusion”, or the formation and growth of bubbles in tissue. Rectified diffusion can cause inflammation and cellular damage because of increased stress and strain (Stroetz et al. 2001; Vlahakis and Hubmayr 2000) and blockage or rupture of capillaries, arteries, and veins (Crum and Mao 1996). Crum and Mao (1996) analyzed bubble growth caused by sound signals at low frequencies (less than 5,000 Hz), long pulse widths, and atmospheric pressure. Their analysis indicates that underwater SPLs exceeding 190 dB_{peak} can cause bubble growth.

Due to differences between species and from variation in exposure type and duration, uncertainty remains as to the degree of potential adverse effect from SPLs between 180 and 190 dB_{peak}. Turnpenny et al. (1994) exposed brown trout (Salmo trutta) to SPLs greater than 170 dB using pure tone bursts for a duration of 90 seconds. This resulted in a mortality rate of 57 percent (after 24 hours) in brown trout; 50 percent mortality (after 24 hours) was observed in bass (Dicentrarchus labrax) and whiting (Merlangius merlangus) exposed to SPLs greater than 176 dB. The authors suggest that the threshold for continuous sounds is, or ought to be, lower than for pulsed sounds, such as seismic airgun blasts. Sound pressures produced by impact pile driving are more similar to those produced by airgun blasts. As such, we conclude that the 170 dB threshold for injury to brown trout identified by Turnpenny et al. is likely lower than the injury threshold associated with underwater SPLs produced by impact pile driving.

As of June 2008, the Service, FHWA, WSDOT, and other signatory agencies have endorsed application of new interim criteria for estimating onset of injury developed by the Fisheries Hydroacoustic Working Group (FHWG 2008). These new interim criteria apply a Sound Exposure Level (SEL) framework for assessing fish injury. For further details, see a sub-section that follows (Estimate of the Extent of Effect).

**Effects of Elevated Underwater SPLs - Behavioral Responses**

Elevated underwater SPLs can elicit a variety of behavioral responses. In general, there is much uncertainty regarding the response of organisms to sources of underwater sound, and there are no experimental data specific to bull trout exposed to underwater sound from impact pile driving. Further confounding the issue, most of the information on behavioral effects of underwater sound is obtained from studies examining pure tone sounds. Sounds generated by impact pile driving are impulsive and are made up of multiple frequencies/ tones, making comparisons with existing data difficult.
Knudsen et al. (1992) studied spontaneous awareness reactions (consisting of reduced heart beat frequency and opercular movements), and avoidance responses to sound in juvenile Atlantic salmon. This study evaluated responses to frequencies ranging from 5 to 150 Hz. With increasing frequency, the difference between the threshold for spontaneous awareness reaction and the estimated hearing threshold also increased. At 5, 60 and 150 Hz, the signal had to exceed the hearing thresholds by 25, 43 and 73 dB, respectively, to elicit reactions. Most of the sound energy produced by impact pile hammers is concentrated at frequencies between 100 and 800 Hz. Salmonids can detect sounds at frequencies between 10 Hz (Knudsen et al. 1997) and 600 Hz (Mueller et al. 1998). Optimal salmonid hearing is thought to be at frequencies of 150 Hz (Hawkins and Johnstone 1978). Therefore, impact pile installation produces sounds within the range of salmonid hearing.

Exposure to elevated SPLs can result in temporary hearing damage referred to as Temporary Threshold Shift (TTS). Most bioacoustic specialists consider TTS to be physiological fatigue and not injury (Popper et al. 2006). However, an organism experiencing TTS may be unable to detect biologically relevant sounds such as approaching predators or prey, and/or mates attempting to communicate. Mesa (1994) examined predator avoidance ability and physiological response of Chinook salmon subjected to various stressors. Test subjects were agitated to cause disorientation. When equal numbers of stressed and unstressed fish were exposed to predators, there was significantly more predation of stressed fish. Shin (1995) reports that impact pile driving may result in agitation of fish, manifested as a change of swimming behavior.

Turnpenny et al. (1994) attempted to determine a level of underwater sound that would elicit behavioral responses in brown trout, bass, sole, and whiting. In brown trout an avoidance reaction was observed above 150 dB\text{rms}, and other reactions (e.g., a momentary startle) were observed at 170-175 dB\text{rms}. The report refers to Hastings’ “safe limit” recommendation of 150 dB\text{rms} and concludes that the Hastings’ “safe limit” provides a reasonable margin below the lowest levels where fish injury was observed. In an associated literature review, Turnpenny and Nedwell (1994) also state that the Hastings’ 150 dB\text{rms} limit did not appear overly stringent and that its application seemed justifiable.

More recently, Fewtrell (2003) held fish in cages in marine waters and exposed them to seismic airgun impulses. The study detected significant increases in behavioral response when sound pressure levels exceeded 158-163 dB\text{rms}. Responses included alarm, faster swimming, tighter grouping, and movement toward the lower portion of the cage. It is difficult to discern the significance of these behavioral responses. The study also evaluated physiological stress response by measuring plasma cortisol and glucose levels and found no statistically significant changes. Conversely, Santulli et al. (1999) found evidence of increased stress hormones after exposing caged European bass to seismic survey noise.

Popper (2003) suggests that the behavioral responses of fishes may include swimming away from the sound source, thereby decreasing potential exposure to the sound, or “freezing” (staying in place), thereby becoming vulnerable to possible injury. Feist et al. (1992) found that impact pile driving affected juvenile pink and chum salmon distribution, school size, and schooling behavior. In general, on days when impact pile driving was not conducted, fish exhibited a more polarized schooling behavior (i.e., movements in a more definite pattern). On days when impact
pile driving was conducted, fish exhibited an active “milling” behavior (i.e., movement in an eddying mass); fish did appear to change their distributions about the site, more commonly orienting and moving towards an acoustically-isolated cove, on days when impact pile driving was conducted. Observations by Feist et al. (1992) suggest that SPLs in excess of 150 dB\textsubscript{rms} may disrupt normal migratory behavior in juvenile salmon.

Clearly, there is a substantial gap in scientific knowledge on the topic of significant behavioral responses to elevated underwater SPLs. The most recent study by Fewtrell (2003) presents some experimental data on behavioral responses of fishes to impulsive sounds above 158 dB\textsubscript{rms}. However, given the large amount of uncertainty that lies not only in extrapolating from experimental data to the field, but also between sound sources (airguns vs. pile driving), and from one species to another, we believe it is appropriate to utilize the most conservative known threshold. As such, for the purposes of this analysis, we expect that SPLs in excess of 150 dB\textsubscript{rms} will cause significant behavioral changes in bull trout and will or may disrupt normal bull trout behaviors (i.e., ability to successfully feed, move and/or shelter).

Estimate of the Extent of Effect

As of June 2008, the Service, FHWA, WSDOT, and other signatory agencies have endorsed application of new interim criteria for estimating onset of injury developed by the Fisheries Hydroacoustic Working Group (2008). These new interim criteria apply a SEL framework for assessing fish injury.

In 2004, the California Department of Transportation and FHWA convened a group of experts in the field of underwater acoustics (referred to as the Fisheries Hydroacoustic Working Group) with the intent of evaluating and refining criteria. This effort included an extensive literature review as the basis for a report on the topic (Hastings and Popper 2005) and a white paper proposing interim criteria (Popper et al. 2006). The Hastings and Popper report (2005) suggested a metric of SEL may be more appropriate for assessing potential injury to fishes from impact pile driving; in part, because the use of SEL allows for the summing of energy over multiple pile driving pulses, which cannot be accomplished when using peak pressure.

The new interim criteria for fish injury identify a single-strike SPL of 206 dB\textsubscript{peak} and 183 dB accumulated SEL for fish less than 2 grams. The interim criteria identify a single-strike SPL of 206 dB\textsubscript{peak} and 187 dB accumulated SEL for fish greater than 2 grams (FHWG 2008).

We use the practical spreading model (Davidson 2004) to estimate the distance from piling installation operations (R; range) at which transmission loss (TL) can be expected to attenuate SPLs and SELs to below thresholds for injury and significant behavioral interference. The calculation \[ TL = 15 \times \log(R) \] assumes that sound levels decrease at a rate of 4.5 dB per doubling distance. This method also assumes that single-strike SELs less than 150 dB do not accumulate to cause injury (“effective quiet”) (Stadler, Pers Comm, 2009).

We used what we consider, for this project, a “worst-case” set of assumptions when applying the practical spreading model. We used single-strike SPLs of 214 dB\textsubscript{peak} and 201 dB\textsubscript{rms}, a single-strike SEL of 186 dB, and assumed as many as 6,000 strikes/day during a single 10- or 12-hour
workday. These assumptions regarding unattenuated pressures are within the range reported in
the literature for similar operations (CALTRANS 2007). We assumed that effective
implementation of a sound attenuation system (i.e., bubble curtain) would achieve a 10 dB
reduction, measured at 10 m from the pile.

Based on the studies and findings presented here and in previous sub-sections, we expect that
subadult and adult bull trout exposed to an accumulated SEL of 187 dB will be injured or killed.
We also expect that subadult and adult bull trout, when exposed to single-strike SPLs of 150
dB$_{rms}$ or above, will or may experience a significant disruption of their normal behaviors (i.e.,
ability to successfully feed, move, and/or shelter). Pile driving and proofing with an impact
hammer may cause bull trout to temporarily avoid the area, impede or discourage free movement
through the area, prevent individuals from exploiting preferred habitats, and/or expose
individuals to less favorable conditions.

Applying the methods of analysis summarized here, impact driving and proofing of steel piles
may kill or injure subadult and adult bull trout to a distance of approximately 1,775 ft (0.34 mi)
from piling installation operations. Impact driving and proofing of steel piles may also
significantly disrupt normal bull trout behaviors to a distance of approximately 3.4 mi. It should
be noted, these estimates of potential effect do not and cannot fully account for additional
transmission loss that is likely to result when piling installation operations are conducted in
shallow waters. The presence of landforms, such as Rennie Island and bends in the lower
Chehalis River, will also limit transmission to the southern portions of Grays Harbor and the
lower few thousand ft of the Chehalis River (Figure 11).

With full implementation of the agreed upon conservation measures, we expect the number of
injured or killed bull trout will be very low (i.e., a few individuals at most). We expect that
impact pile driving operations will significantly disrupt the normal behaviors of a larger number
of subadult and adult bull trout. Impact pile driving and proofing may prevent individuals from
exploiting preferred habitats and could expose individuals to less favorable conditions. Suitable
bull trout rearing and spawning habitats are not present in the action are, and therefore these
operations will have no effect on bull trout rearing and spawning habitat or these essential
behaviors.
Permanent and Temporary Effects to Habitat

Features included in the ALY casting basin launch channel design (i.e., the launch channel footprint, side-slope armor, permanent piling, and associated infrastructure) will result in permanent and temporary adverse effects to bull trout habitat structure, function, and diversity.

Temporary Effects to Habitat

In order to build and maintain the launch channel configuration so as to ensure sufficient depth for vessel operations, the project will dredge between 165,000 and 237,000 cy of sediment from the approximately 2.9 acre dredge prism or footprint over the course of four years (2011-2014) (WSDOT 2010a, p. 2-23). This project element or activity will degrade natural habitats within the footprint (shallow, gently sloping mudflat), by removing native substrate and the associated epibenthic and infaunal communities.

A program of maintenance dredge operations has been proposed at the ALY site specifically because the Chehalis River’s and Grays Harbor’s annual sediment transport rates are great, and the WSDOT and FHWA expect that natural sediment transport dynamics will in-fill the launch channel over time. Similarly, we expect that after the planned six cycles of pontoon construction are complete, and the project ceases to maintain the constructed launch channel (i.e., with follow-up dredge operations), in-fill will begin to reestablish the present contours.

We expect that initial construction of the casting basin launch channel will degrade approximately 2.9 acres of estuarine mudflat, and that measurable effects to bull trout habitat and the bull trout prey base will persist for approximately 3 years after the final of six planned maintenance dredge operations. Bull trout may continue to forage and migrate through this
portion of Grays Harbor, but we expect that foraging opportunities, in particular, will be measurably affected. However, given the amount and quality of affected habitat, the present and projected future condition of the Grays Harbor bull trout prey base, and the ready availability of productive, alternative foraging opportunities, we conclude that these adverse effects to habitat will not significantly disrupt normal bull trout behaviors.

**Permanent Effects to Habitat**

The project will place approximately 70 permanent steel and wood piles, and approximately 18,000 cy of clean riprap armor within the casting basin launch channel footprint and along its tapered side-slopes. This project element or activity will degrade natural habitats within the footprint (shallow, gently sloping mudflat), by removing native substrate and the associated epibenthic and infaunal communities, and by permanently replacing natural forms of habitat structure with piles and armor.

We expect that construction of the casting basin launch channel will permanently degrade approximately 0.8 acre of estuarine mudflat, and that measurable effects to bull trout habitat and the bull trout prey base will persist indefinitely. Bull trout may continue to forage and migrate through this portion of Grays Harbor, but we expect that foraging opportunities, in particular, will be measurably affected. We do not expect that permanent features of the casting basin launch channel will prevent or discourage migration through the area, or expose bull trout to heightened predation risk or other acute or chronic stressors. Furthermore, because of the small amount and low quality of affected foraging habitat, and because productive, alternative foraging opportunities are readily available, we conclude that these adverse effects to habitat will not significantly disrupt normal bull trout behaviors.

**Effects of the Action – Synthesis (Bull Trout)**

We expect that measurable, adverse effects to bull trout, their prey base, and habitat will result from the proposed action. In-water construction and maintenance of the casting basin launch channel includes construction activities we expect will result in measurable, temporary adverse effects to bull trout and their habitat. We also expect that as many as four individual subadult and adult bull trout may become entrained within the ALY casting basin and suffer adverse effects as a result of capture and handling prior to release. Finally, features included in the launch channel design will degrade estuarine mudflat, with potential consequences for bull trout that forage in the immediate vicinity of the ALY site.

Temporary stressors, including fish handling and increases in underwater sound resulting from impact pile driving, have the potential to kill or injure a limited number of subadult and adult bull trout. Temporary exposures may also significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter). These exposures may temporarily cause bull trout to avoid the action area, will impede or discourage free movement through the action area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.
We do not expect that permanent features of the casting basin launch channel will prevent or discourage migration through the area, or expose bull trout to heightened predation risk or other acute or chronic stressors. Furthermore, because of the small amount and low quality of affected foraging habitat, and because productive, alternative foraging opportunities are readily available, we conclude that effects to estuarine mudflat and the associated prey base will not significantly disrupt normal bull trout behaviors.

Based on location and proximity to bull trout core areas and local populations, it is reasonable to conclude that relatively few individuals will be exposed to the action’s short or long term effects. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the proposed action will have no effect on bull trout rearing or spawning habitat, or these essential behaviors.

While we cannot entirely discount the risk of physical injury or mortality as a result of temporary exposures, we expect that the number of killed or injured bull trout will be very low (i.e., a few individuals at most). These subadult and adult bull trout may originate from any of three bull trout core areas (Quinault, Queets, and/or Hoh River core areas), and five (or more) local populations. Because these few individuals originate from any of the five (or more) local populations, we expect that no measurable effect to numbers (abundance) will be evident at the scale of the local populations or core areas.

Temporary exposures resulting in sublethal physiological stress, and/or a significant disruption of normal behaviors, could potentially have consequences for individual growth or long term survival. However, we expect that for most exposed bull trout these potential incremental effects to growth and long term survival will not be measurable. These subadult and adult bull trout may originate from any of three bull trout core areas (Quinault, Queets, and/or Hoh River core areas), and we expect that no measurable effect to numbers (abundance) or reproduction (productivity) will be evident at the scale of the local populations or core areas.

Temporary exposures may impede or discourage free movement through the action area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions. However, the proposed action will not create or contribute to any permanent impediments of the migratory corridor. Any measurable effects to migratory habitat (or migrating individuals) will be temporary, and we expect that no measurable short or long term effects to distribution will be evident at the scale of the local populations or core areas.

**Effects to Bull Trout Critical Habitat**

An earlier section identified the PCEs of bull trout critical habitat and described their baseline condition in the action area (*Status of Critical Habitat in the Action Area*). The following subsections discuss the effects of the action with reference to the six PCEs which are present and may be affected.
Grays Harbor

The action area includes nearshore marine environments less than 10 m in depth. These habitats provide five of the nine PCEs:

(2) Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The proposed action will result in temporary adverse effects to this PCE. Construction activities will impair function of the migratory corridor surrounding the ALY casting basin and launch channel (impact pile driving below the MHHW; initial and follow-up maintenance dredge operations), intermittently but for a term of approximately four years (2011 through 2014). All other project elements and activities will result in no measurable effects to short or long term function of this PCE. We expect that the proposed action will have no measurable, permanent effects to this PCE, and within the action area this PCE will retain its current level of function (moderately impaired).

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

The proposed action will result in both temporary and permanent adverse effects to this PCE. Features included in the casting basin launch channel design (i.e., the launch channel footprint, side-slope armor, permanent piling, and associated infrastructure) will result in both temporary and permanent adverse effects to native substrate and associated epibenthic and infaunal communities. Temporary adverse effects to approximately 2.9 acres of estuarine mudflat will persist for a term of approximately 7 years. Permanent adverse effects, while limited in physical extent (0.8 acre of estuarine mudflat), will persist indefinitely or for the functional life of the constructed features. All other project elements and activities will result in no measurable effects to short or long term function of this PCE. Given the nature, size, and duration of these adverse effects, we expect that within the action area this PCE will retain its current level of function (little or no significant impairment).

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

The proposed action will result in both temporary and permanent adverse effects to this PCE. Features included in the casting basin launch channel design (i.e., the launch channel footprint, side-slope armor, permanent piling, and associated infrastructure) will result in both temporary and permanent adverse effects to native substrate and marine shoreline. Temporary adverse effects to approximately 2.9 acres of estuarine mudflat will persist for a term of approximately 7 years. Permanent adverse effects, while limited in physical extent (0.8 acre of estuarine mudflat), will persist indefinitely or for the functional life of the constructed features. All other project elements and activities will result in no measurable effects to short or long term function
of this PCE. Given the nature, size, and duration of these adverse effects, we expect that within the action area this PCE will retain its current level of function (moderately impaired).

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

The proposed action will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function (little or no significant impairment).

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

The proposed action will result in temporary adverse effects to this PCE. Construction activities will impair water quality (initial and follow-up maintenance dredge operations), intermittently but for a term of approximately four years (2011 through 2014). All other project elements and activities will result in no measurable effects to short or long term function of this PCE. We expect that the proposed action will have no measurable, permanent effects to this PCE, and within the action area this PCE will retain its current level of function (moderately impaired).

In summary, we expect that the action will result in adverse effects to critical habitat resulting from temporary adverse effects to PCEs #2 (migration habitats with minimal impediments) and #8 (water quantity and quality), and very limited, permanent adverse effects to PCEs #3 (food base) and #4 (complex marine shoreline environments).

Lake Washington

The action area includes nearshore freshwater environments less than 10 m in depth. These habitats provide six of the nine PCEs:

(2) Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The proposed action will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function (moderately impaired).

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

The proposed action will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function (moderately impaired).
(4) Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

The proposed action will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function (moderately to severely impaired).

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

The proposed action will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function (moderately impaired).

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

The proposed action will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function (moderately impaired).

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

The proposed action will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function (moderately impaired).

In summary, we expect that the action will result in no measurable effects to short or long term function of the PCEs.

**Indirect Effects (Bull Trout and Critical Habitat)**

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action (USFWS and NMFS 1998).

Potential indirect effects include those resulting from process and stormwater discharges at the casting basin facility (ALY), and those resulting from or associated with extended pontoon moorage in Grays Harbor. These effects were discussed in preceding sub-sections.

No other indirect effects are anticipated. In the event of a catastrophic failure of the existing floating bridge span, this action includes emergency repair activities that would rebuild or
reestablish the as-built, four-lane configuration along its current alignment. Therefore, the proposed action will not result in changes in the use or function of the highway infrastructure, and no attendant effects to land use (pattern or rate) are foreseeable.

**Effects of Interrelated & Interdependent Actions (Bull Trout and Critical Habitat)**

Interrelated actions are defined as actions “that are part of a larger action and depend on the larger action for their justification”; interdependent actions are defined as actions “that have no independent utility apart from the action under consideration” (50 CFR section 402.02).

The proposed action includes use of the DMMP open-water disposal site(s) near the mouth of Grays Harbor as an interrelated action. Operation of the DMMP site(s) has undergone independent section 7 consultation (FWS Ref. No. 1-3-06-I-0469; *Grays Harbor and Chehalis River Navigation Channel Maintenance Dredging Program, FY2007-2011*).

No measurable effects to bull trout individuals, their prey base, or habitat are expected to result from interrelated or interdependent actions.

**CUMULATIVE EFFECTS (Bull Trout and Critical Habitat)**

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. 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.

A wide variety of government, public non-governmental, local, tribal, and private partners are taking coordinated actions to improve water quality conditions in the greater Grays Harbor-Chehalis basin. The WDOE and its partners are implementing several TMDLs aimed at controlling point and non-point sources of fecal coliform, nutrients, and biological oxygen demand. Additional TMDLs target improved dissolved oxygen and temperature conditions throughout the basin, and control (or remediation) of dioxin levels in the inner Grays Harbor. A comprehensive Water Quality Implementation Plan was approved during 2004, and projected future actions include planning and technical assistance provided to individual farms and property owners, conservation acquisitions and easements, and wastewater treatment plant upgrades (municipal and industrial). Partners in this process include the Cities of Hoquiam, Aberdeen, Montesano, Centralia, and Chehalis; the Ports of Grays Harbor, Centralia, and Chehalis; local conservation districts and community groups; the Confederated Tribes of the Chehalis Indian Reservation; the Capitol Land Trust and Chehalis River Land Trust; Grays Harbor Community College; and, the Chehalis Basin Partnership {{13956 WDOE 2008}}. Together, and individually, these partners continue to identify and prioritize for implementation plans, projects, and actions intended to restore water quality and proper ecosystem function along the lower Chehalis River and Grays Harbor.

Future State and local actions which may affect Lake Washington FMO habitat also include implementation of TMDLs. Planning and implementation has begun for fecal coliform,
dissolved oxygen, and temperature TMDLs in the Bear, Evans, and Cottage Creek sub-watersheds, and for fecal coliform in the Swamp Creek and North Creek sub-watersheds of the Sammamish River basin (WDOE 2010b). State, local, tribal, and private partners are also taking actions aimed at directly improving instream habitat conditions for the benefit of native resident and anadromous fish.

Future local actions that may affect bull trout and their habitat include planned growth consistent with the land use and growth management plans of Grays Harbor, Lewis, King, and Snohomish Counties, and the cities located therein. Additional residential, commercial, and industrial development (or redevelopment) is certain to occur in the action area. Planned growth consistent with the land use and growth management plans of these municipalities, will, over the long-term, result in additional effects to watershed functions, surface water quality, and instream habitat. However, with full implementation of the Comprehensive Plans, Shoreline Management Programs, and Critical Area Ordinances administered by these municipalities, and in conjunction with State and County environmental permit requirements (including those requirements established for the protection of wetlands and for the regulation of private and municipal stormwater discharges), effects to ecological functions may be reduced.

Taken as a whole, the foreseeable future State, tribal, local, and private actions may have both beneficial effects and adverse effects to bull trout and their habitat. Some of these actions (e.g., implementation of the TMDL clean-up plans) are likely to improve conditions in the action area for bull trout. Over time, other actions may further degrade conditions for bull trout in the action area.

CONCLUSION

We have reviewed the current status of the bull trout in its coterminous range, the current status of designated bull trout critical habitat in its coterminous range, the environmental baseline for the action area, the direct and indirect effects of the proposed action, the effects of interrelated and interdependent actions, and the cumulative effects that are reasonably certain to occur in the action area.

It is our Biological Opinion that the action, as proposed, is not likely to jeopardize the continued existence of the bull trout in its coterminous range. This determination is based on the following:

- The action area contains non-core FMO habitat supporting low numbers of subadult and adult bull trout. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the proposed action will have no effect on bull trout rearing or spawning habitat, or these essential behaviors.

- The proposed action incorporates both permanent design elements and conservation measures which will reduce effects to habitat and avoid and minimize impacts during construction. The action's temporary adverse effects are limited in both physical extent and duration. The action’s permanent adverse effects to bull trout habitat (i.e., estuarine mudflat and associated prey base at the ALY casting basin launch channel) will not
significantly disrupt normal bull trout behaviors. The action’s temporary and permanent effects will not preclude bull trout from foraging, migrating, and overwintering within the action area.

- With full implementation of the proposed conservation measures, we expect that low numbers of subadult and adult bull trout will be adversely affected by construction activities. Exposure to construction activities may kill or injure a limited number of bull trout, may result in sublethal physiological stress with potential consequences for individual growth and/or long term survival, and will significantly disrupt normal bull trout behaviors (feeding, moving, and sheltering). As many as four individual subadult and adult bull trout may become entrained within the ALY casting basin and suffer adverse effects as a result of capture and handling prior to release. However, because these subadult and adult bull trout may originate from any of three bull trout core areas (Quinault, Queets, and/or Hoh River core areas), and five (or more) local populations, we expect that any resulting temporary or long term effects to bull trout numbers (abundance) or reproduction (productivity) will not be measurable at the scale of the local populations or core areas.

- With full implementation of the proposed conservation measures, we expect that the action’s permanent adverse effects to bull trout habitat (i.e., estuarine mudflat and associated prey base at the ALY casting basin launch channel) will not significantly disrupt normal bull trout behaviors.

- Any measurable effects to migratory habitat (or migrating individuals) will be temporary. We expect that no measurable short or long term effects to distribution will be evident at the scale of the local populations or core areas (Quinault, Queets, and/or Hoh River core areas).

- The proposed mitigation activities will restore habitat and habitat functions, with potential benefits for bull trout and their prey.

- The anticipated direct and indirect effects of the action, combined with the effects of interrelated and interdependent actions, and the cumulative effects associated with future State, tribal, local, and private actions will not appreciably reduce the likelihood of survival and recovery of the species. The anticipated direct and indirect effects of the action (permanent and temporary) will not measurably reduce bull trout numbers, reproduction, or distribution at the scale of the core areas or Olympic Peninsula interim recovery unit. The anticipated direct and indirect effects of the action will not alter the status of bull trout at the scale of the Olympic Peninsula interim recovery unit or coterminous range.

It is our Biological Opinion that the action, as proposed, will not destroy or adversely modify bull trout critical habitat. This determination is based on the following:

- The action area includes portions of Grays Harbor and Lake Washington, including nearshore marine and freshwater environments less than 10 m in depth. These nearshore
waters have been designated as bull trout critical habitat and provide six of the nine PCEs. The action area also includes open-water shipping routes between Grays Harbor and Lake Washington. However, no incremental effects to the physical, biotic, or chemical environment are reasonably foreseeable as a result of pontoon transport along open-water shipping routes.

- The action area provides non-core FMO habitat and supports low numbers of subadult and adult bull trout. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the proposed action will have no effect on bull trout rearing or spawning habitat, including PCE #6 (substrates to ensure spawning success and juvenile survival).

- The proposed action incorporates both permanent design elements and conservation measures which will reduce effects to critical habitat and avoid and minimize impacts during construction. The action's temporary (construction-related) adverse effects are limited in both physical extent and duration.

- Construction activities will impair water quality surrounding the ALY casting basin launch channel, intermittently but for a term of approximately four years (2011-2014). Beyond the period of construction, we expect that the proposed action will have no measurable, permanent effects to PCE #8 (water quantity and quality). Within the action area critical habitat will retain its current level of function (moderately impaired).

- Construction activities will impair function of the migratory corridor surrounding the ALY casting basin launch channel, intermittently but for a term of approximately four years (2011 through 2014). Beyond the period of construction, we expect that the proposed action will have no measurable, permanent effects to PCE #2 (migration habitats with minimal impediments). Within the action area critical habitat will retain its current level of function (moderately impaired).

- The action will have permanent adverse effects to bull trout critical habitat PCE #3 (food base) and PCE #4 (complex marine shoreline environments), associated with or resulting from permanent features of the ALY casting basin launch channel. The action will permanently degrade approximately 0.8 acre of estuarine mudflat, with persistent measurable effects to the bull trout prey base and bull trout habitat. However, we conclude that these permanent effects will not significantly disrupt normal bull trout behaviors, and within the action area critical habitat will retain its current level of function. At the scale of the action area, we expect that PCE #3 (food base) will fully retain all current function (little or no significant impairment).

- Within the action area, bull trout critical habitat will retain its current ability to establish functioning PCEs. The anticipated direct and indirect effects of the action, combined with the effects of interrelated and interdependent actions, and the cumulative effects associated with future State, tribal, local, and private actions will not prevent the PCEs of critical habitat from being maintained, and will not degrade the current ability to establish functioning PCEs at the scale of the action area. Critical habitat within the action area
will continue to serve the intended conservation role for the species at the scale of the core areas (Quinault, Queets, and/or Hoh River core areas), Olympic Peninsula interim recovery unit, and coterminous range.

INCIDENTAL TAKE STATEMENT

Section 9 of the 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 defined by the Service as an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the 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 FHWA so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by this incidental take statement. If the FHWA (1) fails to assume and implement the terms and conditions or (2) fails to require the contractor or applicant 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 FHWA 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 section 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

We anticipate that take in the form of harm and harassment of subadult and adult bull trout from the Quinault, Queets, and/or Hoh River core areas will result from the proposed action.

1. Incidental take of bull trout in the form of harm (physical injury or mortality) resulting from fish entrainment, capture, and handling at the ALY pontoon construction facility (casting basin).

   - One adult or subadult bull trout will be harmed during six construction cycles completed between winter 2012 and spring 2014.
2. Incidental take of bull trout in the form of harassment (stress not reaching the level of physical injury) resulting from fish entrainment, capture, and handling at the ALY pontoon construction facility (casting basin).

- Three adult or subadult bull trout will be harassed during six construction cycles completed between winter 2012 and spring 2014.

The following forms of incidental take will be difficult to detect or quantify for the following reasons: 1) the low likelihood of finding dead or injured adults, subadults, or juveniles; 2) delayed mortality; and, 3) the relationship between habitat conditions and the distribution and abundance of individuals is imprecise such that a specific number of affected individuals cannot be practically obtained. Where this is the case, we use post-project habitat conditions as a surrogate indicator of take.

3. Incidental take of bull trout in the form of harassment resulting from degraded surface water quality and exposure to conditions of elevated turbidity. Water quality will be degraded intermittently during construction and maintenance of the ALY casting basin launch channel (i.e., initial dredge and maintenance dredge operations). Take will result when levels of turbidity reach or exceed the following:

   i) 160 NTUs above background at any time; or

   ii) 60 NTUs above background for more than 1 hour, continuously; or

   iii) 22 NTUs above background for more than 7 hours, cumulatively, over a 10-hour workday; or

   iv) 8 NTUs above background for durations approaching 2 days (24 hours), continuously.

- All subadult and adult bull trout within a distance of approximately 750 ft from the launch channel dredge footprint will be harassed for a period of 60 working days between June 16, 2011, and February 28, 2112, plus 90 additional working days (6 maintenance dredge operations) between June 16 and February 28 (2012-2014).

4. Incidental take of bull trout in the form of harm as a direct effect of exposure to elevated underwater SPLs resulting from impact pile driving and proofing of approximately 60 steel piles, between June 16, 2011, and February 28, 2012.

- All adult or subadult bull trout within approximately 1,775 ft (0.34 mi) of piling installation operations (145 acres) in Grays Harbor and the lower Chehalis River will be harmed.

5. Incidental take of bull trout in the form of harassment as a direct effect of exposure to elevated underwater SPLs resulting from impact pile driving and proofing of approximately 60 steel piles, between June 16, 2011, and February 28, 2012.
- All adult or subadult bull trout within approximately 3.4 mi of piling installation operations (2,020 acres) in Grays Harbor and the lower Chehalis River will be harassed.

EFFECT OF THE TAKE

In the accompanying Opinion, we determined that the level of anticipated take is not likely to result in jeopardy to the bull trout.

REASONABLE AND PRUDENT MEASURES

The proposed action incorporates design elements and conservation measures which we expect will reduce permanent effects to habitat and avoid and minimize impacts during construction. We expect that the FHWA and WSDOT will fully implement these measures, and therefore they have not been specifically identified as Reasonable and Prudent Measures or Terms and Conditions.

The following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the impact of incidental take to bull trout:

1. Minimize and monitor incidental take caused by fish entrainment, capture, and handling at the ALY pontoon construction facility (casting basin) during each of six construction cycles.

2. Minimize and monitor incidental take caused by temporary water quality stressors resulting from the initial and maintenance dredge operations conducted at the ALY casting basin launch channel.

3. Minimize and monitor incidental take caused by elevated underwater SPLs from impact driving and proofing of steel piles.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the FHWA must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

The following terms and conditions are required for the implementation of RPM 1:

1. The FHWA and WSDOT shall provide a detailed Fish Handling Plan to the Washington Fish and Wildlife Office in Lacey, Washington (Attn: Transportation Planning Branch) no later than March 31, 2011. The FHWA and WSDOT shall also provide as-built
drawings or final plan sheets for the ALY casting basin, with details depicting the casting basin floor, screened pumps and intakes, power crowder, fish-handling boxes, and aeration system(s).

2. The FHWA and WSDOT shall ensure that water quality conditions are adequate to hold and transport captured bull trout. The operations shall use aerators or air stones to provide for the circulation of clean, cold, well-oxygenated water.

3. The FHWA and WSDOT shall ensure that a qualified biologist(s) oversees implementation of the Fish Handling Plan.

4. In the event that fish capture requires the use of electrofishing equipment, the FHWA and WSDOT shall use the minimum voltage, pulse width, and rate settings necessary to immobilize fish. Use of electrofishing equipment shall conform to WSDOT Fish Exclusion Protocols and Standards (WSDOT 2009), and guidelines outlined by the National Marine Fisheries Service (NMFS 2000).

5. The FHWA and WSDOT shall document and report all bull trout encountered during fish capture and handling operations. The FHWA and WSDOT shall submit a monitoring report to the Washington Fish and Wildlife Office in Lacey, Washington (Attn: Transportation Planning Branch), within 30 days of the fish capture and handling operations associated with each pontoon production cycle.

The following terms and conditions are required for the implementation of RPM 2:

1. The FHWA and WSDOT shall monitor turbidity levels in Grays Harbor while conducting the initial and maintenance dredge operations at the ALY casting basin launch channel.

2. The FHWA and WSDOT shall perform intensive monitoring during the first three days of each dredge operation:

   a. Samples shall be collected at a distance of 300 ft from the sediment-generating activity.

   b. Samples shall be collected at 30-minute intervals, beginning one hour after the start of sediment-generating activity. If turbidities measured over the course of three consecutive 30-minute sample intervals do not exceed 22 NTUs over background, the next sample shall be taken 4 hours later (unless operation has ceased for the day), or when there is a visually appreciable increase in turbidity.

   c. Samples shall be collected to establish background turbidity levels away from the influence of sediment-generating activity. In the event of a visually appreciable change in background turbidity, an additional sample shall be taken.
3. If intensive monitoring demonstrates that turbidities do not exceed 22 NTUs over background over the first three days of the dredge operation, the FHWA and WSDOT shall monitor turbidity levels once daily per workday for the remainder of the dredge operation.

4. If, at any time, turbidities measured at 300 ft exceed 60 NTUs over background, the FHWA and WSDOT shall collect samples at a second station, 750 ft from the sediment-generating activity, at 30-minute intervals, for the remainder of the workday.

5. If turbidity levels measured at 750 ft from the sediment-generating activity exceed 160 NTUs above background at any time, 60 NTUs above background for more than 1 hour continuously, or 22 NTUs above background for more than 7 hours, cumulatively, over a 10-hour workday, then the amount of take authorized by the Incidental Take Statement will have been exceeded. Sediment-generating activities shall cease, and the FHWA or WSDOT shall contact a consulting biologist with the Transportation Planning Branch at the Washington Fish and Wildlife Office in Lacey, Washington (360-753-9440).

6. If, in cooperation with other permit authorities, the FHWA and WSDOT develop a functionally equivalent monitoring strategy, they may submit this plan to the Service for review and approval in lieu of the above monitoring requirements. The strategy must be submitted to the Service a minimum of 60 days prior to dredging operations. In order to be approved for use in lieu of the above requirements, the plan must meet each of the same objectives.

7. The FHWA and WSDOT shall submit a monitoring report to the Washington Fish and Wildlife Office in Lacey, Washington (Attn: Transportation Planning Branch), by April 30 following each season during which dredge operations were conducted. The report shall include, at a minimum, the following: (a) dates and times of construction activities, (b) monitoring results, sample times, locations, and measured turbidities (in NTUs), (c) summary of construction activities and measured turbidities associated with those activities, (d) summary of corrective actions taken to reduce sediment/turbidity, and (e) a quantitative waste characterization or profile for all sediments and water disposed at an in-water dredged material disposal site(s).

The following terms and conditions are required for the implementation of RPM 3:

1. The FHWA and WSDOT shall use a vibratory pile hammer to the fullest extent practicable when installing steel piles below the MHHW.

2. The FHWA and WSDOT shall monitor in-water sound generation and attenuation while installing steel piles with an impact pile hammer (WSDOT 2010, Appendix C).

3. The FHWA and WSDOT shall conduct impact pile driving operations without the use of a noise attenuation device only when proofing piles in water less than two feet deep, or as necessary to determine baseline SPLs as specified in the hydroacoustic monitoring plan.
4. The FHWA and WSDOT shall:

   a. Use a noise attenuation device consisting of a bubble curtain (i), or functional equivalent (ii), when impact driving and proofing steel piles in water greater than two feet deep.

     i. A bubble curtain utilizing air compressor(s), supply lines to deliver air, distribution manifolds or headers, perforated aeration pipe(s), and a frame; the bubble curtain shall:

         (1) Include a frame which facilitates transport and placement of the system, keeps the aeration pipes stable, and provides ballast to counteract the buoyancy of the aeration pipes in operation.

         (2) Include an aeration pipe system consisting of multiple layers of perforated pipe rings, stacked vertically in accordance with the following:

         | Water Depth (m) | No. of Layers |
         |-----------------|--------------|
         | Less than 5     | 2            |
         | 5 to less than 10| 4            |
         | 10 to less than 15| 7           |
         | 15 to less than 20| 10          |
         | 20 to less than 25| 13          |

         (3) Arrange the pipe rings (in all layers) in a geometric pattern such that the pile being driven is completely enclosed by bubbles for the full depth of the water column and with a radial dimension such that the rings are no more than 0.5 meter from the outside surface of the pile.

         (4) Ensure that the lowest layer of perforated aeration pipe is in contact with the substrate (without sinking into the substrate) and accommodates sloped conditions.

         (5) Size the air holes 1.6 mm (1/16-inch) in diameter and space them approximately 20 mm (3/4 inch) apart. Air holes with this size and spacing shall be placed in four adjacent rows along the pipe to provide uniform bubble flux.

         (6) Provide a bubble flux of 3.0 cubic meters per minute per linear meter of pipe in each layer (32.91 cubic ft per minute per linear foot of pipe in each layer). The total volume of air per layer is the product of the bubble flux and the circumference of the ring:
\[ V_t = 3.0 \text{ m}^3/\text{min}/\text{m} \times \text{Circ of the aeration ring in m} \]

or

\[ V_t = 32.91 \text{ ft}^3/\text{min}/\text{ft} \times \text{Circ of the aeration ring in ft} \]

(7) Provide meters as follows:

(a) Pressure meters shall be installed at all inlets to aeration pipelines and at points of lowest pressure in each branch of the aeration pipeline.

(b) Flow meters shall be installed in the main line at each compressor and at each branch of the aeration pipelines at each inlet. In applications where the feed line from the compressor is continuous from the compressor to the aeration pipe inlet the flow meter at the compressor can be eliminated.

(c) Flow meters shall be installed according to the manufacturer’s recommendation based on either laminar flow or non-laminar flow.

ii. A functional equivalent to the design described above (3.a.i.). Design specifications and monitoring reports or other information documenting equivalent function shall be submitted to the Service for review a minimum of 60 days prior to impact pile driving and proofing.

b. Conduct a performance test of the noise attenuation device, prior to any impact pile driving or proofing. If a bubble curtain is utilized, the performance test shall confirm the calculated pressures and flow rates at each manifold ring.

c. Ensure that a qualified individual is present during all impact pile driving and proofing operations to observe and report any indications of dead, injured, or distressed fish.

d. Document the effectiveness of the noise attenuation device through hydroacoustic monitoring of a minimum of five piles, as early in the project as possible. Factors to consider in identifying the piles to be monitored include, but are not limited to: bathymetry of the project site, total number of piles to be impact driven and proofed, depth of water, and distance from shore. This monitoring shall include SPLs, and single strike and cumulative SELs, with and without use of the noise attenuation device, monitored at a distance of 10 meters from the pile at mid-water depth.

5. The FHWA and WSDOT shall contact the Service within 24 hours if the hydroacoustic monitoring indicates that the SPLs will exceed the extent of take exempted in the Biological Opinion. The FHWA shall consult with the Service regarding modifications to the proposed action in an effort to reduce the SPLs below the limits of take and continue hydroacoustic monitoring.
6. The FHWA and WSDOT shall submit a monitoring report to the Washington Fish and Wildlife Office in Lacey, Washington (Attn: Transportation Planning Branch), by April 30, 2012. The report shall include the following information:

   a. Size and type of piles driven and proofed;

   b. The impact hammer force used to drive and proof piles;

   c. A description of the monitoring equipment;

   d. The distance between hydrophone and pile;

   e. The depth of the hydrophone;

   f. The distance from the pile to the wetted perimeter;

   g. The depth of water;

   h. The depth into the substrate the pile was driven and proofed;

   i. The physical characteristics of the bottom substrate into which the piles were driven and proofed; and

   j. The results of the hydroacoustic monitoring, including the frequency spectrum, SPLs, and single-strike and cumulative SEL. The report must also include the ranges and means for peak, rms, and SELs.

We expect that the amount or extent of incidental take described above will not be exceeded as a result of the proposed action. The RPMs, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. FHWA and WSDOT must provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

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

CONSERVATION RECOMMENDATIONS

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

The Service recommends the following to FHWA:

1. The FHWA and WSDOT should seek to create and/or enhance additional intertidal mudflat habitat at the Grass Creek mitigation site.

2. The FHWA and WSDOT should adaptively manage plans for annual video reconnaissance or dive inspections of the pontoon mooring system (anchor chains/cables). If these inspections find entrained fishing gear, and especially if this occurs prior to mooring the full complement of finished pontoons (10 rafts of 3 or 4 pontoons each; 40 anchors), the FHWA and WSDOT should consider whether twice-annual inspections are warranted as a means of reducing the risk of fish or wildlife entanglement.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR section 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.
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APPENDICES

Appendix A: Status of the Species (Bull Trout; Coterminous Range)
Appendix B: Status of Designated Critical Habitat (Bull Trout; Coterminous Range)
Appendix C: Quinault, Queets, and Hoh River Core Areas (Bull Trout)
APPENDIX A. Status of the Species (Bull Trout; Coterminous Range)
Appendix A:

Status of the Species (Bull Trout; Coterminous Range)

Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluens*us) 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 (Bond 1992, p. 4; Brewin and Brewin 1997, pp. 209-216; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 715-720).

Throughout its range, the bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007; Rieman et al. 2007). 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 (USFWS 2002a; 2004a; 2004b). 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 (USFWS 2002a; 2004a; 2004b).

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 (USFWS 2002a; 2004a; 2004b) 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 (USFWS 2002a; 2004a; 2004b). 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 (USFWS 2002a; 2004a; 2004b).

**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 (USFWS 2004b). The draft bull trout recovery plan (USFWS 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 (USFWS 2004b).
Klamath River Interim Recovery Unit

This interim recovery unit currently contains three core areas and seven 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 ((USFWS 2002b). Bull trout populations in this interim recovery unit face a high risk of extirpation (USFWS 2002b). The draft Klamath River bull trout recovery plan (USFWS 2002b) 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 three core areas (USFWS 2002b).

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, p.1177). 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 (USFWS 2002d) 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, 2 are at low risk, and 2 are at unknown risk (USFWS 2005).

Coastal-Puget Sound Interim Recovery Unit

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous, 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 (USFWS 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 (USFWS 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 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 (USFWS 2002c). Currently, bull trout are widely distributed in the St. Mary-Belly 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 (USFWS 2002c). 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 (USFWS 2002c). The draft St. Mary-Belly bull trout recovery plan (USFWS 2002c) 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 (Fraley and Shepard 1989; Leathe and Graham 1982; 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 (Goetz 1989; Pratt 1985). 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; Howell and Buchanan 1992; Pratt 1992; Rich 1996; Rieman and McIntyre 1993; Rieman and McIntyre 1995; Sedell and Everest 1991; 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 (Mike Gilpin in litt. 1997; Rieman et al. 1997; Rieman and McIntyre 1993). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to natal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993; Spruell et al. 1999). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams (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 (Baxter et al. 1997; Pratt 1992; Rieman et al. 1997; Rieman and McIntyre 1993). 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) (Buchanan and Gregory 1997; Goetz 1989; McPhail and Murray 1979). 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 (Buchanan and Gregory 1997; Fraley and Shepard 1989; Rieman et al. 1997; Rieman and McIntyre 1993; Rieman and McIntyre 1995). 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 L. Gamett, Salmon-Challis National Forest, pers. comm. 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 Bjorrm 1989; Pratt 1992; Rich 1996; Sedell and Everest 1991; Sexauer and James 1997; Thomas 1992; 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).

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

A literature review conducted by the Washington Department of Ecology (WDOE 2002) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). In a laboratory study conducted in Canada, researchers found that low oxygen levels retarded embryonic development in bull trout (Giles and Van der Zweep 1996 in Stewart et al. 2007). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

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 (Brenkman and Corbett 2005; Frissell 1993; Goetz et al. 2004). 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 (Frissell 1999; MBTSG 1998; Rieman and McIntyre 1993). 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; Donald and Alger 1993; Goetz 1989). Subadult and adult migratory bull trout feed on various fish species (Brown 1994; Donald and Alger 1993; Fraley and Shepard 1989; Leathe and Graham 1982). Bull trout of all sizes other than fry have been found to eat fish half their length (Beauchamp and VanTassell 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) (Goetz et al. 2004; WDFW et al. 1997).

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).

Changes in Status of the Coastal-Puget Sound Interim Recovery Unit

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 (HCP) 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.
Changes in Status of the Saint Mary-Belly River Interim Recovery Unit

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-Belly 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.
LITERATURE CITED


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WDFW (Washington Department of Fish and Wildlife), FishPro Inc., and Beak Consultants. 1997. Grandy Creek trout hatchery biological assessment. Washington Department of Fish and Wildlife, Olympia, WA.

APPENDIX B. Status of Designated Critical Habitat (Bull Trout; Coterminous Range)
Appendix B: Status of Designated Critical Habitat (Bull Trout; Coterminous Range)

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.

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

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 32º to 72 ºF (0º to 22 ºC) but are found more frequently in temperatures ranging from 36º to 59 ºF (2º 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 (MLLW) and minus 10 meters (m) mean higher high-water (MHHW),
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 MLLW.

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, USFWS 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 (USFWS 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). This condition reflects the condition of bull trout habitat.

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; MBTSO 1998); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993; 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.
LITERATURE CITED


APPENDIX C. Quinault, Queets, and Hoh River Core Areas (Bull Trout)
Appendix C:
Quinault, Queets, and Hoh River Core Areas (Bull Trout)

Hoh River Core Area

The Hoh River core area comprises the Hoh and South Fork Hoh Rivers and associated tributaries. Active glaciers at the headwaters of the Hoh River watershed deliver both cold water and “glacial flour” to the mainstem. Bull trout occur throughout the mainstem Hoh and South Fork Hoh Rivers. However, bull trout were not detected in 17 of 18 tributaries surveyed in the upper Hoh River. A series of cascades at river mile 48.5 in the upper Hoh River may be a barrier to upstream fish passage. There is a potential barrier to upstream fish passage in the South Fork Hoh River at river mile 14.

Resident and migratory life history forms of bull trout, including anadromous forms, likely occur in the Hoh River core area. Genetic analysis has identified only bull trout (no Dolly Varden) in the Hoh core area (Spruell and Maxwell 2002).

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 (USFWS 2004).

Number and Distribution of Local Populations

Two local populations have been identified: 1) Hoh River above the confluence with the South Fork Hoh River, and 2) South Fork Hoh River. With only two local populations, the bull trout in this core area is considered at increased risk of extirpation and adverse effects from random naturally occurring events (see "Life History").

Adult Abundance

Historically the Hoh core area likely comprised the largest population of bull trout on the Washington coast (Mongillo 1993). Currently there is insufficient information for a precise estimate of adult bull trout abundance, but the Hoh core area probably supports at least 500 but fewer than 1,000 adults. With fewer than 1,000 adults, this population is considered at increased risk of genetic drift.

Productivity

Bull trout in the Hoh core area are considered at risk of extirpation until sufficient information is collected to properly assess productivity.

Connectivity

Barriers to fish movement and migration in the Hoh core area include improperly sized or installed culverts in several locations. The mainstem is disconnected from off-channel habitats and adjacent riparian forest by riprap for bank armoring along the Upper Hoh Road. Impassable
barriers of cedar spalt debris have formed in coastal rivers and streams in the core area. Holding and rearing areas for adult bull trout during spawning migration, and for juveniles during rearing movements among different stream reaches, are reduced due to reduction of instream large woody debris. Despite these habitat alterations, migratory bull trout persist in the Hoh River core area. Recent studies have shown that bull trout in the Hoh River core area move into adjacent independent coastal tributaries (Brenkman and Corbett 2003). Bull trout in this core area have diminished risk of extirpation from habitat isolation and fragmentation.

Changes in Environmental Conditions and Population Status

Since the bull trout listing, Federal actions occurring in the Hoh River core area have resulted in harm to, or harassment of, bull trout. These actions include statewide Federal restoration programs that include riparian restoration, replacement of fish passage barriers, and fish habitat improvement projects; federally funded transportation projects involving repair and protection of roads and bridges; and section 10(a)(1)(B) permits for HCPs addressing forest management practices. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Hoh core area. The number of non-Federal actions occurring in the Hoh River core area since the bull trout listing is unknown.

State forest practice regulations were significantly revised in 2000, following the Forest and Fish agreement (FFR 1999g; WFPB 2001). Revised regulations increased riparian protection, unstable slope protection, and recruitment of large wood; road standards improved significantly over the old regulations. Because there is biological uncertainty associated with some of the prescriptions, the Forest and Fish agreement relies on an adaptive management program for assurance that the new rules will meet the conservation needs of bull trout. The updated regulations will significantly reduce the level of future timber harvest impacts to bull trout streams on private lands. However, most negative effects from past forest practices will likely continue to be a threat for decades.

Reasons for Decline

Threats to bull trout in the Hoh River core area include:

- Past and current timber harvest and harvest-related activities, such as roads, have degraded habitat conditions (e.g., fisheries, water quality, and connectivity) in the lower and middle watershed. Numerous steep slopes are susceptible to mass wasting and channelized landslides. The resulting substantial increase in the number of debris flows has reduced macroinvertebrate populations in the Hoh River. Riparian roads have increased fine sediments and peak flows.

- Other impacts from logging include reduced amounts of large woody debris, altered stream morphologies (especially reduced pool area and quality), and loss of riparian vegetation leading to increased water temperatures. Cedar spalts in several tributaries block fish passage, impede water flows, increase water temperature, leach tannins into the water, inhibit plant growth in the riparian area, and form dams that carve stream banks and increase fine sediments.
• Riprap for bank armoring along the Upper Hoh Road has prevented channel migration and formation of new habitats, created unnatural meander patterns, and disconnected the mainstem from off-channel habitats and adjacent riparian forest.

Tribal and recreational fisheries cause incidental mortality of bull trout and are likely affecting the local populations.

Black spot disease may be a factor in the decline of bull trout in the Hoh River.

**Queets River Core Area**

The Queets core area comprises the Queets River, all of its tributaries, and the estuary. The Queets mainstem, except for the lower 8 miles, is contained entirely within a narrow corridor of the Olympic National Park. The tributaries flow through the Quinault Indian Reservation, Olympic National Forest, and State and private landholdings.

Fluvial, resident, and anadromous life history forms of bull trout occur in the Queets core area. 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 (USFWS 2004).

**Number and Distribution of Local Populations**

The upper Queets watershed is located largely within the Olympic National Park and is difficult to access. The Olympic Peninsula Bull Trout Recovery Team identified one local population: the Queets River and associated tributaries upstream from the confluence with Tshletshy Creek. Bull trout occur in the Queets River up to river mile 46; in the Salmon, Sams, and Clearwater Rivers; and in Matheny Creek. The Queets River mainstem and tributaries are designated as mixed use (i.e., rearing, foraging, migration, overwintering). Spawning has been documented in the mainstem river between river miles 45 and 48. With only one local population, bull trout in this core area are considered at increased risk of extirpation and adverse effects from random naturally occurring events (see "Life History").

**Adult Abundance**

The Queets core area likely supports at least 500 but fewer than 1,000 adults. With fewer than 1,000 adults, the bull trout population in this core area is considered at increased risk of genetic drift.

**Productivity**

The bull trout population in the Queets core area is considered to be at risk of extirpation until sufficient information is collected to properly assess productivity.
Connectivity

Bull trout occur in the Queets River from the marine waters of the anadromous zone up to the headwater spawning sites. Although there are barriers to movement (e.g., impassable culverts) in some tributaries, there are no barriers to movement in the mainstem Queets River. This migratory corridor is relatively pristine and intact.

Changes in Environmental Conditions and Population Status

Since the bull trout listing, several Federal actions occurring in the Queets core area have resulted in harm to, or harassment of, bull trout. These actions include forest management activities and culvert replacements outside of the local population. The culvert replacements are designed to provide long-term benefits to the watershed and bull trout. The more recent forest management activities that are consistent with the Quinault Indian Reservation 10-year Forest Management Plan incorporate riparian buffers and conservation measures designed to reduce adverse effects to bull trout. No section 6 or section 10(a)(1)(A) permits have been issued in the

Queets Core Area for Effects to Bull Trout Through Capture and Handling.

The number of non-Federal actions occurring in the Queets core area since the bull trout listing is unknown. Activities currently conducted on an infrequent basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and probably negatively affect bull trout.

Threats

Threats to bull trout in the Queets core area include:

- Past logging and logging-related activities, such as roads, degraded habitat conditions in the Clearwater, Sams, and Salmon Rivers and Matheny Creek.

- Road densities in the Clearwater River basin are high, and roads throughout the Queets core area are in need of repair.

- Bull trout are susceptible to incidental mortality associated with fisheries that target salmon and steelhead at the mouth of the Queets River and incidental hooking mortality from recreational fishers.

Quinault Core Area

The Quinault core area comprises the mainstem Quinault (East Fork) and North Fork Quinault Rivers, associated tributaries, the estuary of the river, and Lake Quinault. Fifty-one percent of the core area lies within the Olympic National Park, 32 percent is owned by the Quinault Indian Nation, and 13 percent is managed by the Olympic National Forest. The remaining 4 percent are private landholdings; Rayonier Timberlands Company is the largest private landowner.
Fluvial, adfluvial, anadromous and, possibly, resident life history forms of bull trout occur in the Quinault core area. 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 (USFWS 2004).

Number and Distribution of Local Populations

Two local populations have been identified: 1) North Fork Quinault River and its associated tributaries, and 2) upper mainstem Quinault River, upstream from the confluence with the North Fork Quinault River. These two local populations occur entirely within the Olympic National Park. Although there may be more than two local populations, there is insufficient information at this time to identify additional local populations. Dolly Varden occur with bull trout in the upper mainstem Quinault River. There is no evidence of hybridization or introgression between the two species (Leary and Allendorf 1997).

Bull trout occur from the headwaters to the estuary and in numerous tributaries above the lake. Little is known about bull trout in the lower Quinault River below Lake Quinault, but bull trout have been observed in the Cook Creek watershed, which likely provides foraging and overwintering habitat. Above Lake Quinault bull trout have been observed in numerous tributaries to both the North Fork Quinault River and the upper Quinault River.

Although spawning sites have not been located in the Quinault core area, the presence of multiple age classes of bull trout in both local populations indicates spawning and rearing does occur. With only two local populations, bull trout in this core area are considered at increased risk of extirpation and adverse effects from random naturally occurring events.

Adult Abundance

Currently there is insufficient information for a precise estimate of adult bull trout abundance. However, the Quinault core area probably supports at least 500 but fewer than 1,000 adults. With fewer than 1,000 adults, this population is considered at increased risk of genetic drift.

Productivity

Bull trout in the Quinault core area are considered at risk of extirpation until sufficient information is collected to properly assess productivity.

Connectivity

Migratory bull trout occur in both local populations in the Quinault core area. Adequate connectivity between the two local populations and throughout the core area diminishes the risk of extirpation of bull trout in the core area from habitat isolation and fragmentation.
Changes in Environmental Conditions and Population Status

Since the bull trout listing, several Federal actions occurring in the Quinault core area have resulted in harm to, or harassment of, bull trout. These actions primarily consist of forest management activities and road repair outside of the local populations. Capture and handling during implementation of section 6 and section 10(a)(1)(A) permits have directly affected bull trout in the Quinault core area. The only known Federal action occurring in a local population was a road reconstruction adjacent to the upper mainstem Quinault River. In general, the road repair actions were designed to provide long-term benefits to the watershed and bull trout. The more recent forest management activities that are consistent with the Quinault Indian Reservation 10-year Forest Management Plan incorporate riparian buffers and conservation measures designed to reduce adverse effects to bull trout from timber harvest activities and road construction and maintenance.

The number of non-Federal actions occurring in the Quinault core area since the bull trout listing is unknown. Activities conducted on a regular basis, such as emergency flood control, development, and infrastructure maintenance, affect riparian and instream habitat and likely negatively affect bull trout.

Threats

Threats to bull trout in the Quinault core area include:

- Tributaries and rivers outside of the Olympic National Park have been affected by past logging.

- Current and long-term historical impacts from roads and transportation networks affect fisheries, water quality, and connectivity. The core area below Lake Quinault has been modified by extensive road construction and timber harvest activities.

- Bull trout are susceptible to incidental mortality associated with fisheries that target salmon and steelhead at the mouth of the Quinault River and to incidental hooking mortality from recreational anglers.

- Physical reductions of stream channel depths and cover habitat, along with flow regime changes in the mid-to-lower subbasins, have altered migratory corridors.
APPENDIX D. Sediment Analysis Framework (2010)
DETERMINING EFFECTS FOR SECTION 7 CONSULTATIONS

There are numerous factors that can influence project-specific sediment effects on bull trout and other salmonids. These factors include the concentration and duration of sediment input, existing sediment conditions, stream conditions (velocity, depth, etc.) during construction, weather or climate conditions (precipitation, wind, etc.), fish presence or absence (bull trout plus prey species), and best management practice effectiveness. Many of these factors are unknown.

Newcombe and Jensen (1996) and Anderson et al. (1996) provide the basis for analyzing sediment effects to bull trout and other salmonids and their habitat. Newcombe and Jensen (1996) conducted a literature review of pertinent documents on sediment effects to salmonids and nonsalmonids. They developed a model that calculated the severity of ill effect (SEV) to fish based on the suspended sediment dose (exposure) and concentration. No data on bull trout were used in this analysis. Anderson et al. (1996), using the methods used by Newcombe and Jensen (1996), developed a model to estimate sediment impacts to salmonid habitat.

A 15-point scale was developed by Newcombe and Jensen (1996, p. 694) to qualitatively rank the effects of sediment on fish (Table 1). Using a similar 15-point scale, Anderson et al. (1996) ranked the effects of sediment on fish habitat (Table 2).

We analyzed the effects on different bull trout life history stages to determine when adverse effects of project-related sediment would occur. Table 3 shows the different ESA effect calls for bull trout based on severity of ill effect.

The effect determination for a proposed action
should consider all SEV values resulting from the action because sediment affects individual fish differently depending on life history stage and site-specific factors. For juvenile bull trout, an SEV of 5 is likely to warrant a “likely to adversely affect” (LAA) determination. However, abandonment of cover (SEV 2), or an avoidance response (SEV 3), may result in increased predation risk and mortality if habitat features are limiting in the project’s stream reach. Therefore, a LAA determination may be warranted at an SEV 2 or 3 level in certain situations. For subadult and adult bull trout, however, abandonment of cover and avoidance may not be as important. A higher SEV score is more appropriate for adverse effects to subadult and adult bull trout. In all situations, we assume that SEV scores associated with adverse effects are also sufficient to represent a likelihood of harm or harass1.

When evaluating impacts to habitat as a surrogate for species effects, adverse effects may be anticipated when there is a notable reduction in abundance of aquatic invertebrates, and an alteration in their community structure. These effects represent a reduction in food for bull trout and other salmonids, and correspond to an SEV of 7 – moderate habitat degradation.

Newcombe and Jensen (1996) used six data groups to conduct their analysis. These groups were 1) juvenile and adult salmonids (Figure 1), 2) adult salmonids (Figure 2), 3) juvenile salmonids (Figure 3), 4) eggs and larvae of salmonids and non-salmonids (Figure 4), 5) adult estuarine nonsalmonids (no figure provided), and 6) adult freshwater nonsalmonids (no figure provided). No explanation was provided for why juvenile and adult salmonids were combined for group 1. As juveniles are more adapted to turbid water (Newcombe 1994, p. 5), their SEV levels are generally lower than for adult salmonids given the same concentration and duration of sediment (Figures 1-3).

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1 Harm and harass in this context refers to the FWS’s regulatory definition at 50 CFR 17.3. E.g., Harm means “an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering.”
Table 3 – ESA Effect calls for different bull trout life stages in relation to the duration of effect and severity of ill effect. Effect calls for habitat, specifically, are provided to assist with analysis of effects to individual bull trout.

<table>
<thead>
<tr>
<th></th>
<th>SEV</th>
<th>ESA Effect Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg/alevin</td>
<td>1 to 4</td>
<td>Not applicable - alevins are still in gravel and are not feeding.</td>
</tr>
<tr>
<td></td>
<td>5 to 14</td>
<td>LAA - any stress to egg/alevin reduces survival</td>
</tr>
<tr>
<td>Juvenile</td>
<td>1 to 4</td>
<td>NLAA</td>
</tr>
<tr>
<td></td>
<td>5 to 14</td>
<td>LAA</td>
</tr>
<tr>
<td>Subadult and Adult</td>
<td>1 to 5</td>
<td>NLAA</td>
</tr>
<tr>
<td></td>
<td>6 to 14</td>
<td>LAA</td>
</tr>
<tr>
<td>Habitat</td>
<td>1 to 6</td>
<td>NLAA</td>
</tr>
<tr>
<td></td>
<td>7 to 14</td>
<td>LAA due to indirect effects to bull trout</td>
</tr>
</tbody>
</table>

The figures of Newcombe and Jensen (1996) have been modified in this document. In each figure, values (in mg/L) are provided for each duration to determine when adverse effects would occur. Specific values are also given for when harm would be likely to occur. For example:

Figure 1 – This figure is for both juveniles and adults. From Table 2, bull trout are “likely to be adversely affected” given an SEV of 5. On Figure 1, a sediment concentration of 99 mg/L for one hour is anticipated to be the maximum concentration for an SEV of 4. At 100 mg/L, an SEV of 5 occurs. In addition, one hour of exposure to 5,760 mg/L is the maximum for an SEV of 7. Exposure to 5,761 mg/L for one hour would warrant an SEV of 8. This would be the threshold between harassment and harm. An SEV of 7 would be harassment, and an SEV of 8 would be considered harm.

The following provides some guidance on use of the figures.

Definitions from Newcombe and Jensen (1996, p. 696). These definitions are provided for consultations that may have impacts to bull trout prey such as Chinook and coho salmon.

Eggs and larvae – eggs, and recently hatched fish, including yolk-sac fry, that have not passed through final metamorphosis.

Juveniles – fry, parr, and smolts that have passed through larval metamorphosis but are sexually immature.

Adults – mature fish.
Bull trout use:

Newcombe and Jensen (1996) conducted their analysis for freshwater, therefore the use of the figures within this document in marine waters should be used with caution.

Figure 1 – Juvenile and Adult Salmonids. This figure should be used in foraging, migration and overwintering (FMO) areas. In FMO areas, downstream of local populations, both subadult and adult bull trout may be found.

Figure 2 – Adult Salmonids. This figure will not be used very often for bull trout. There may be circumstances, downstream of local population spawning areas that may have just adults, but usually this would not be the case. Justification for use of this figure should be stated in your consultation.

Figure 3 – Juvenile Salmonids. This figure should be used in local population spawning and rearing areas outside of the spawning period. During this time, only juveniles and sub-adults should be found in the area. Adults would migrate to larger stream systems or to marine water. If the construction of the project would occur during spawning, then Figure 1 should be used.

Figure 4 – Eggs and Alevins. This figure should be used if eggs or alevins are expected to be in the project area during construction.

Figure 5 – Habitat. This figure should be used for all projects to determine whether alterations to the habitat may occur from the project.

**Background and Environmental Baseline**

In determining the overall impact of a project on bull trout, and to specifically understand whether increased sediment may adversely affect bull trout, a thorough review of the environmental baseline and limiting factors in the stream and watershed is needed. The following websites and documents will help provide this information.

1. Washington State Conservation Commission’s Limiting Factors Analysis. A limiting factors analysis has been conducted on watersheds within the State of Washington. Limiting factors are defined as “conditions that limit the ability of habitat to fully sustain populations of salmon, including all species of the family Salmonidae.” These documents will provide information on the current condition of the individual watersheds within the State of Washington. The limiting factors website is [http://salmon.scc.wa.gov](http://salmon.scc.wa.gov). Copies of the limiting factors analysis can be found at the Western Washington Fish and Wildlife Library.

2. Washington Department of Fish and Wildlife’s (1998) Salmonid Stock Inventory (SaSI). The Washington Department of Fish and Wildlife (WDFW) inventoried bull trout and Dolly Varden (S. malma) stock status throughout the State. The intent of the inventory is to help identify available information and to guide future restoration planning and implementation. SaSI defines the stock within the watershed, life history
forms, status and factors affecting production. Spawning distribution and timing for different life stages are provided (migration, spawning, etc.), if known. SaSi documents can be found at [http://wdfw.wa.gov/fish/sasi/index.htm](http://wdfw.wa.gov/fish/sasi/index.htm).

3. **U.S. Fish and Wildlife Service’s (USFWS 1998a) Matrix of Diagnostics/Pathways and Indicators (MPI).** The MPI was designed to facilitate and standardize determination of project effects on bull trout. The MPI provides a consistent, logical line of reasoning to aid in determining when and where adverse affects occur and why they occur. The MPI provides levels or values for different habitat indicators to assist the biologist in determining the level of effects or impacts to bull trout from a project and how these impacts may cumulatively change habitat within the watershed.

4. **Individual Watershed Resources.** Other resources may be available within a watershed that will provide information on habitat, fish species, and recovery and restoration activities being conducted. The action agency may cite a publication or identify a local watershed group within the Biological Assessment or Biological Evaluation. These local groups provide valuable information specific to the watershed.

5. **Washington State Department of Ecology (WDOE) - The WDOE has long- and short- term water quality data for different streams within the State.** Data can be found at [http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html](http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html). Clicking on a stream or entering a stream name will provide information on current and past water quality data (when you get to this website, scroll down to the Washington map). This information will be useful for determining the specific turbidity/suspended sediment relationship for that stream (more information below).

6. **Washington State Department of Ecology (WDOE) - The WDOE has also been collecting benthic macroinvertebrates and physical habitat data to describe conditions under natural and anthropogenic disturbed areas.** Data can be found at [http://www.ecy.wa.gov/programs/eap/fw_benth/index.htm](http://www.ecy.wa.gov/programs/eap/fw_benth/index.htm). You can access monitoring sites at the bottom of the website.

7. **U.S. Forest Service, Watershed Analysis Documents - The U.S. Forest Service (USFS) is required by the Record of Decision for Amendments to the USFS and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl to conduct a watershed analysis for watersheds located on FS lands.** The watershed analysis determines the existing condition of the watershed and makes recommendations for future projects that move the landscape towards desired conditions. Watershed analysis documents are available from individual National Forests or from the Forest Plan Division.

8. **U.S. Fish and Wildlife Service - Bull Trout Recovery Plans and Critical Habitat Designations.** The draft Bull Trout Recovery Plan for the Columbia River Distinct Population Segment (DPS) (also the Jarbidge River and the St. Mary-Belly River DPS) and the proposed and final critical habitat designations provide current species status, habitat requirements, and limiting factors for bull trout within specific individual
recovery units. These documents are available from the Endangered Species Division as well as the Service’s web page (www.fws.gov).

These documents and websites provide baseline and background information on stream and watershed conditions. This information is critical to determining project-specific sediment impacts to the aquatic system. The baseline or background levels need to be analyzed with respect to the limiting factors within the watershed.

**Consultation Sediment Analysis**

The analysis in this section only applies to construction-related physiological and behavioral impacts, and the direct effects of fine sediment on current habitat conditions. Longer-term effects to habitat from project-induced channel adjustments, post-construction inputs of coarse sediment, and secondary fine sediment effects due to re-mobilization of sediment during the following runoff season, are not included in the quantitative part of this effects determination. Those aspects are only considered qualitatively.

The background or baseline sediment conditions within the project area or watershed will help to determine whether the project will have an adverse effect on bull trout. The following method should be followed to assist in reviewing effects determinations and quantifying take in biological opinions.

1) Determine what life stage(s) of bull trout will be affected by sedimentation from the project. Life history stages include eggs and alevins, juveniles, and sub-adults and adults. If projects adhere to approved work timing windows, very few should be constructed during periods when eggs and alevins are in the gravels. However, streambed or bank adjustments may occur later in time and result in increased sedimentation during the time of the year when eggs and alevins may be in the gravels and thus affected by the project.

2) Table 4 provides concentrations, durations, and SEV levels for different projects. This table will help in analyzing similar projects and to determine sediment level impacts associated with that type of project. Based on what life history stage is in the project area and what SEV levels may result from the project, a determination may be made on effects to bull trout. (Table 4 located on the Q drive: Q:\linked Literature Materials\Species & Issues & BO Templates with RefMan\Sediment Issue Paper)

3) Once a “likely to adversely affect” determination has been made for a project, the figures in Newcombe and Jensen (1996) or Anderson et al. (1996) are used to determine the concentration (mg/L) at which adverse effects and “take” will occur (see Figures 1-5). For example, if a project is located in FMO habitat, Figure 1 would be used to determine the concentrations at which adverse effects will occur. Since Figure 1 is used for both adults and juveniles, an SEV of 5 (for juveniles) is used (see Table 2). For (a.) the level when instantaneous adverse effects occur, find the SEV level of 5 in the one hour

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2 For the remainder of the document, references to “adverse effects” also refer to harm and harass under 50 CFR 17.3.
column. The corresponding concentration is the instantaneous value where adverse affects occur. In this example, it is 148 mg/L. For (b), (c), and (d), adverse effects will occur when sediment concentrations exceed SEV 4 levels. The exact concentrations for this have been provided. For each category, find the SEV 4 levels and the corresponding concentration levels are the values used.

For impacts to individual bull trout, adverse effects would be anticipated in the following situations:

a. Any time sediment concentrations exceed 148 mg/L over background.
b. When sediment concentrations exceed 99 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 40 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 20 mg/L over background for over seven hours cumulatively.

For habitat effects, use Figure 5 and the same procedure as above for individual bull trout. For example, adverse effects would be expected to occur in the following situations:

a. Any time sediment concentrations exceed 1,097 mg/L over background.
b. When sediment concentrations exceed 885 mg/L over background for more than one hour continuously.
c. When sediment concentrations exceed 345 mg/L over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 167 mg/L over background for over seven hours cumulatively.

4) Because sediment sampling for concentration (mg/L) is labor intensive, many applicants prefer to monitor turbidity as a surrogate. To do this, the sediment concentration at which adverse effects to the species and/or habitat occurs is converted to NTUs. Two methods, regression analysis and turbidity to suspended solid ratio, are available for this conversion. The regression analysis method should be used first. If not enough data are available then the turbidity to suspended solid ratio method should be used.

a. Data – as described above in Background and Environmental Baseline, an attempt should be made to find turbidity and suspended solid information from the project area, action area, or the stream in which the project is being constructed. This information may be available from the Tribes, watershed monitoring groups, etc. Try to obtain information for the months in-water construction will occur, which is usually during the fish timing window (in most cases, July through September). If you are unable to find any data for the action area, use the WDOE water quality monitoring data. The following are the steps you need to go through to locate the information on the web and how to download the data:
i. Go to the WDOE webpage (http://www.ecy.wa.gov/programs/eap/fw_riv/rv_main.html).

ii. When you get to the website, the page will state “River and Stream Water Quality Monitoring.” If you scroll down the page, you will see the following text and map.

iii. The map shows all the water quality monitoring stations in Washington. You can click on a watershed, or go to Option 3, click on the down arrow and find your watershed. You will then get the following webpage. This is an example for the Nooksack River.
iv. This webpage shows you all the monitoring stations in this watershed. Scrolling down a little on the webpage, you get a list of the monitoring stations and the years that data were collected. The more years in which data were collected the better; however, you want to pick the monitoring station closest to the project site. If a project is located on a tributary, do not use data from the main river in the watershed. Find a monitoring station on a tributary and use that data. **Justification for the use of the data needs to be made in the BO.** The following language was used in the Anthracite Creek Bridge Scour BO. Changes to this paragraph to represent regression analysis are not italicized.

“The guidance of Newcombe and Jensen (1996) requires a measurement of the existing suspended sediment concentration levels (mg/L) and duration of time that sediment impacts would occur. The Service used data available on the Washington Department of Ecology (WDOE) website to determine a ratio of turbidity (NTU) to suspended solids (mg/L)(website to find the correlation between turbidity and suspended solids) in Anthracite Creek. No water quality data was available for Anthracite Creek, so the Service used water quality monitoring data from a different tributary within the Snohomish River watershed. Patterson Creek, which is a tributary to the Snoqualmie River, was used to determine the ratio of turbidity to suspended solids (correlation between turbidity and suspended solids). The Service believes that Patterson Creek would have very comparable water quality data as Anthracite Creek. The turbidity to suspended solid ratio for Patterson Creek is 1:2.4 during the proposed months of construction (July through September).” Delete the last sentence for regression analysis or put in the equation used for analysis and the R².
v. When you select the monitoring station, the following webpage appears. This monitoring station is on the Nooksack River at North Cedarville.

vi. Moving down the webpage, you find the following. The page shows the years data were collected and 4 to 6 tabs that provide different information. Click on the finalized data tab.
vii. Selecting the finalized data, a new page comes up; scrolling down that page you see the following. The top part of the page shows the finalized data for the most recent year data were collected. Below the data is a box that says “Bulk data download options...” Click on the “save to file” button for the 14 standardized data parameters. Follow the instructions to save this file. This saves all the data from that monitoring station so the regression analysis can be conducted.
viii. Open Excel and open the file that was just downloaded. Verify that all data appear to be available. After you have worked with these files, you will get an idea if something appears wrong. If the data looks like something is wrong, verify it by comparing the data to the finalized data on the webpage (look at each year’s finalized data). After the file is open, delete all columns except the date, sussol (mg/L) and turb (NTU).

ix. Next delete the rows that do not need to be included. Only save the months in which the project will be constructed. For example, if work will be conducted during the work timing window of July 15 through August 31, delete all rows except those that contain data for July and August. The data consist of one data collection point each month. In addition, delete any values that have a “U” or “J” in the column to the right of the NTU value. This data may not be accurate; data may not be detectable at reported level or is an estimated value. The blue cells indicate the value exceeds water quality standards or contrasted strongly with historical results.

x. After deleting the unnecessary columns and rows, your data should contain 5 columns. You can now delete the columns to the right of the values. This will give you 3 columns. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.

b. Regression analysis. Once you have the data reduced to the months construction will occur, you can determine the relationship between turbidity and suspended
solids using regression. The following steps will provide the regression equation using the data obtained above. These steps are for Excel 2007.

i. With your mouse, highlight both columns of data (suspended solid and turbidity), but do not include the heading information.

ii. Then click on “Insert”, “Scatter” and then the graph that does not have any lines on it (should be the upper left graph).

iii. The graph is placed on your Excel sheet, so move it over so you can see all the data and the graph.

iv. Now add the trendline to the graph. This is done by clicking (left button) once on any of the points on the graph. Then right click. A window pops open and click on “Add Trendline.” A “Format Trendline” window appears. Make sure Linear is checked, and down on the bottom, check Display Equation on chart and Display R-squared value on chart. Click on close.

v. The equation that you want to use for your conversion from NTUs to suspended solids is now on the graph. Hopefully, your R-squared value is also high. This gives you an indication of how well your data fits the line. A one (1) is perfect. If this number is low (and a ballpark figure is less than 0.60) then you may want to consider using the ratio method to determine your conversion from NTUs to suspended solids.

1. Outliers – sometimes there will be data that will be far outside the norm. These values can be deleted and that will help increase your R-squared value. If you are good at statistics there are ways of
determining outliers. If not, you will probably just use the data as is, unless you think something is really not right, then you may want to delete those data points.

vi. Using the equation for the regression analysis, convert the sediment concentrations found for when adverse affects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let’s say our NTU to suspended solid equation is: 
\[ y = 1.6632x - 0.5789 \]
Adverse effects would then occur at (solve for \( x \)):

For impacts to the species adverse effect would occur in the following situations:

a. Any time sediment concentrations exceed 89 NTU over background.

b. When sediment concentrations exceed 60 NTU over background for more than one hour continuously.

c. When sediment concentrations exceed 24 NTU over background for more than three hours cumulatively.

d. When sediment concentrations exceeded 12 NTU over background for over seven hours cumulatively.

For impacts to habitat

a. Any time sediment concentrations exceed 660 NTU over background.

b. When sediment concentrations exceed 532 NTU over background for more than one hour continuously.

c. When sediment concentrations exceed 208 NTU over background for more than three hours cumulatively.

d. When sediment concentrations exceeded 101 NTU over background for over seven hours cumulatively.

c. Turbidity:suspended solid ratio: To calculate the turbidity to suspended solid ratio you need to download the same data off the Ecology website as described above. Sometimes the monitoring stations have limited amount of data and by running the regression analysis it is possible to get a negative slope (an increase in turbidity results in a decrease in suspended solids). This is very unlikely to occur in a stream. Other times you have so few data points that the \( R^2 \) value shows that the correlation between suspended solid and turbidity is not very good. When \( R^2 \) values are below 0.60, determine the turbidity to suspended solid ratio. The following are the steps needed to calculate the turbidity to suspended solid ratio.

i. After you deleted all the columns and rows of data you do not need, you should have 3 columns of data. The first being the date, the second column contains the suspended solid data (mg/L) and the third column the turbidity (NTU) data.
ii. Calculate the average turbidity and suspended solid value for all data. Average the turbidity column and average the suspended solid column.

iii. Calculate the turbidity to suspended solid value for the average turbidity and average suspended solid value obtained in ii. Divide the average suspended solid value by the average turbidity value.

iv. If any outliers are identified, they should be deleted. Recalculate the turbidity:suspended solid ratio if outliers have been removed (should automatically be done when values are deleted).

vii. Using the turbidity to suspended solid ratio, convert the sediment concentrations found for when adverse effects occur to bull trout and their habitat (number 3 above) to NTUs. For our example, let’s say our NTU to suspended solid ratio is 2.1. Adverse effects to the species would then occur in the following situations:

a. Any time sediment concentrations exceed 70 NTU over background.
b. When sediment concentrations exceed 47 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 19 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 10 NTU over background for over seven hours cumulatively.

Adverse effects to the species through habitat impacts would occur in the following situations:
a. Any time sediment concentrations exceed 522 NTU over background.
b. When sediment concentrations exceed 421 NTU over background for more than one hour continuously.
c. When sediment concentrations exceed 164 NTU over background for more than three hours cumulatively.
d. When sediment concentrations exceeded 80 NTU over background for over seven hours cumulatively.

5) Determine how far downstream adverse effects and take will occur. There is no easy answer for determining this. Table 4 provides some sediment monitoring data for a variety of projects. These data can be used to determine the downstream extent of sediment impacts for a project. Note that in Table 4 there is not a single downstream point that can always be used because sediment conveyance and mixing characteristics are different for each stream. **An explanation of how the distance downstream was determined needs to be included in each BO.**
Figure 1 – Severity of ill effect scores for juvenile and adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

**Juvenile and Adult Salmonids**

**Average severity of ill effect scores**

<table>
<thead>
<tr>
<th>Concentration (mg/L)</th>
<th>162755</th>
<th>59874</th>
<th>22026</th>
<th>8103</th>
<th>2981</th>
<th>1097</th>
<th>403</th>
<th>148</th>
<th>55</th>
<th>491</th>
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16
Figure 2 - Severity of ill effect scores for adult salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 5 and 6 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

### Adult Salmonids

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Figure 3 - Severity of ill effect scores for juvenile salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for harassment, and the concentration between 7 and 8 represents the threshold for harm.

## Juvenile Salmonids

**Average severity of ill effect scores**

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Figure 4 - Severity of ill effect scores for eggs and alevins of salmonids. The individual boxes provide the maximum concentration for that SEV. The concentration between 4 and 5 represents the threshold for both harassment and harm to eggs and alevins.

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**Eggs and Alevins of Salmonids**

Average severity of ill effect scores
Figure 5 - Severity of ill effect scores for salmonid habitat. The individual boxes provide the maximum concentration for that SEV. The concentration between 6 and 7 represents the threshold for anticipating adverse effects to bull trout through habitat modifications.

**Salmonid Habitat**

**Average severity of ill effect scores**

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