Draft

Coastal Recovery Unit

Implementation Plan

for

Bull Trout Recovery Plan

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Prepared by

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Coastal Recovery Unit

Draft Recovery Unit Implementation Plan

Introduction

This draft recovery unit implementation plan (RUIP) describes the threats to bull trout and the site-specific management actions necessary for recovery of the species within the Coastal Recovery Unit, including estimates of time required and cost. This document supports and complements the Draft Revised Recovery Plan for the Coterminous U.S. Population of Bull Trout (USFWS 2014a), which described recovery criteria and a general range-wide recovery strategy for the species, but deferred detailed discussion of species status and recovery actions within each of the six recovery units to RUIPs developed in coordination with State, Federal, Tribal, and other conservation partners. After we have received public comment on the draft RUIPs, we will incorporate changes as appropriate and release a final version in conjunction with the final recovery plan.

The Coastal Recovery Unit (RU) is located within western Oregon and Washington. Major geographic regions include the Olympic Peninsula, Puget Sound, and Lower Columbia River basins (Figure A-1). The Olympic Peninsula and Puget Sound geographic regions also include their associated marine waters (Puget Sound, Hood Canal, Strait of Juan de Fuca, and Pacific Coast), which are critical in supporting the anadromous[1] life history form. The Lower Columbia River major geographic region includes the lower mainstem Columbia River, an important migratory waterway essential for providing habitat and population connectivity within this region. In the Coastal Recovery Unit, we have designated 21 existing bull trout core areas, including the recently reintroduced Clackamas River population, and identified 4 core areas that could be re-established (Figure A-1). Core areas within the recovery unit are distributed among these three major geographic regions (Puget Sound also includes one core area that is actually part of the lower Fraser River system in British Columbia, Canada).

The Puget Sound region contains eight core areas (Chilliwack River, Nooksack River, Upper Skagit River, Lower Skagit River, Stillaguamish River, Snohomish and Skykomish Rivers, Chester Morse Lake, and Puyallup River). The Olympic Peninsula region contains six core areas

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

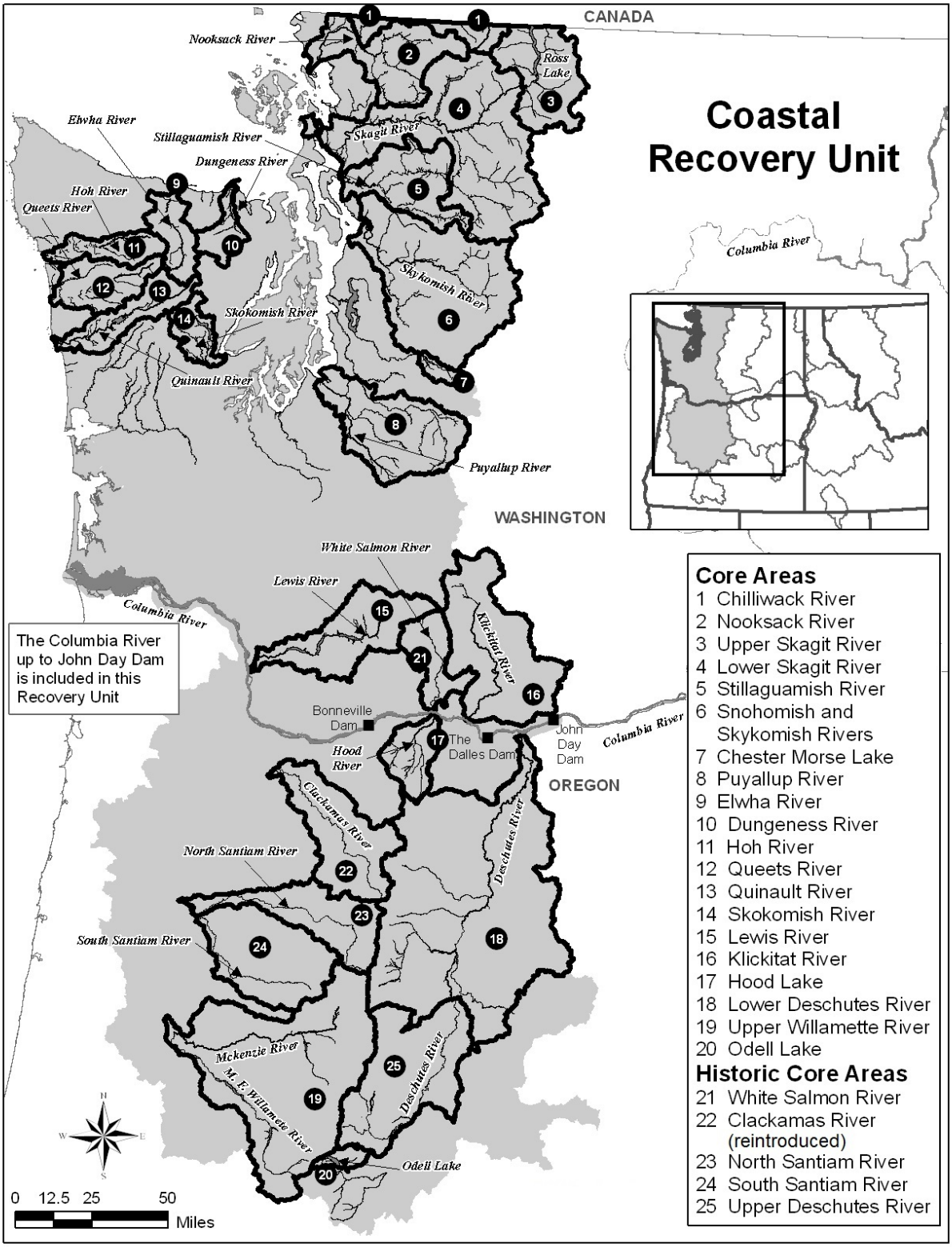

Figure A-1. Map of the Coastal Recovery Unit (Core Areas) for bull trout.

(Dungeness River, Elwha River, Hoh River, Queets River, Quinault River, and Skokomish River). The Lower Columbia River region contains seven core areas (Lewis River, Klickitat River, Hood River, Lower Deschutes River, Upper Willamette River, Odell Lake, and Clackamas River). The only core areas currently supporting anadromous populations of bull trout are located within the Puget Sound and Olympic Peninsula regions. Although bull trout in the Lower Columbia River region share a genetic past with the Puget Sound and Olympic Peninsula regions, it is unclear to what extent the Lower Columbia River core areas supported the anadromous life history in the past or could in the future (Ardren *et al*. 2011). Adult bull trout are still occasionally observed within the lower mainstem Columbia River, but any further migration by bull trout in this region to the Pacific Ocean is largely unknown. Historically, the Lower Columbia River region is believed to have largely supported the fluvial[2] life history form; however, hydroelectric facilities built within a number of the core areas have isolated or fragmented watersheds and largely replaced the fluvial life history with the adfluvial[3] form.

Two core areas within the Coastal Recovery Unit (Chilliwack River and Upper Skagit River) are functionally transboundary with British Columbia, Canada. The boundaries of these core areas should extend into British Columbia from a functional standpoint, and our recovery criteria and recovery actions have taken this into consideration.

There are four core areas within the Coastal Recovery Unit that have been identified as current bull trout population strongholds. These are the Lower Skagit and Upper Skagit core areas in the Puget Sound region, the Quinault River core area in the Olympic Peninsula region, and the Lower Deschutes River core area in the Lower Columbia River region. These are considered the most stable and abundant bull trout populations within the Coastal Recovery Unit.

Within the Coastal Recovery Unit, waterbodies used by foraging bull trout are often shared among multiple core areas/populations and are outside of the boundaries of the natal core areas. Although individuals from various core areas may “mix” in these waters while overwintering, migrating and foraging, individuals maintain a strong fidelity for their natal core area and appear to only occasionally spawn in a different core area. However, for long-term population resiliency it is important that where natural connectivity exists or existed between core areas, it is maintained or restored in order to provide opportunities for genetic mixing (although infrequent) and population refounding. The connectivity provided by these foraging, migration, and overwintering (FMO) areas allows for the continued natural population dynamics that core areas have evolved under.

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

In the Coastal Recovery Unit, we have designated 10 FMO areas that occur outside of core area boundaries and may be used by bull trout originating from multiple core areas (Figure A-2). These shared FMO areas are particularly important to the anadromous and fluvial life history forms due to their complex migratory patterns associated with foraging and overwintering. These shared FMO areas are also critical to maintaining or reestablishing the expression of the anadromous life history behavior within the recovery unit. Unique to the Puget Sound and Olympic Peninsula regions of this recovery unit is the frequent use of a number of independent (*i.e.*, separated by marine waters so not directly connected to a core area), non-natal river or creek basins for foraging and overwintering by anadromous bull trout. Two of these shared FMO areas (Lower Nisqually River and Chehalis River/Grays Harbor-Satsop River) likely supported spawning populations of bull trout in the past based on historical accounts. Only foraging individuals from other core areas are believed to currently use these systems and in much lower numbers. In the Lower Columbia River region of the recovery unit, the mainstem Columbia River provides productive foraging habitats for migratory bull trout and critical connectivity among core areas for potential gene flow and population refounding. Current bull trout presence in the lower mainstem Columbia River may reflect the strength of local populations within regional core areas and the presence of suitable migration corridors between core areas and the Columbia River. There are fewer occurrences of bull trout in the Columbia River where poorer habitat conditions and passage barriers exist in these core area tributaries (Willamette, Lewis, Hood, Klickitat, and Deschutes Rivers) and/or contain reduced population levels. Greater use of the mainstem Columbia River is expected as habitat conditions improve and bull trout population abundances increase through implementation of the recovery plan. The lower section of the Columbia River is very large, and it is difficult to sample and detect bull trout in their current low numbers, consequently information on their period of use is limited.

It is anticipated that the mainstem Columbia River will have increasing importance as key foraging and overwintering habitat for fluvial bull trout as passage improvements are made at hydroelectric facilities currently isolating individual core areas and as populations improve in status. In addition, if the anadromous life history can still be expressed within some core areas of the Lower Columbia River region, the Columbia River will also provide a critical connection to marine habitats. Historic records documented that bull trout (referred to as Dolly Varden at the time) were caught in fish wheels operated on the lower mainstem Columbia in the late 1800s (Donaldson and Cramer 1971), as well as observations in the lower Columbia River near Jones Beach, Willapa Bay, and Grays Harbor and lower Chehalis River (Mongillo 1993; Jeanes and Morello 2006), and observations in the fish ladder at Bonneville dam (USFWS 2010). Bull trout captured and radio tagged in Chehalis River/Grays Harbor (about 45 miles (72 kilometers[km])

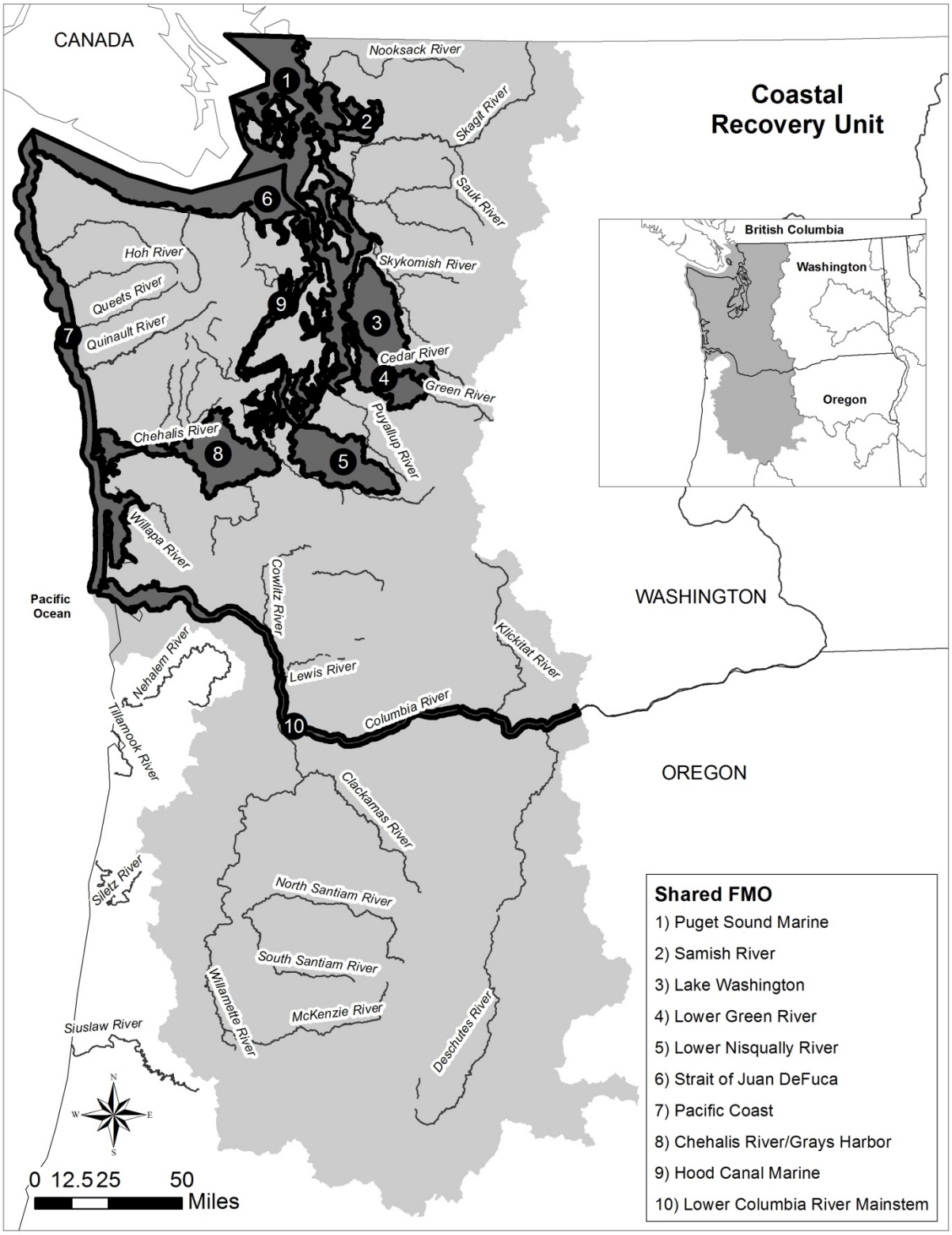

Figure A-2. Map of the Coastal Recovery Unit (Shared FMO) for Bull Trout.

north of the mouth of the Columbia River) were relocated in populations on the Olympic Peninsula, more than 80 miles to the north (Jeanes and Morello 2006); fish known for their extensive and complex migratory behavior (Goetz *et al*. 2004; Brenkman *et al*. 2007).

The Coastal RU also overlaps a number of evolutionarily significant units of salmon and distinct population segments of steelhead that are also listed under the Endangered Species Act. These include Puget Sound Chinook (*Oncorhynchus tshawytscha*), Hood Canal summer-run chum (*O*. k*eta*), Puget Sound steelhead (*O*. *mykiss*), Lower Columbia River Chinook, Upper Willamette River Chinook, Columbia River chum, Lower Columbia River coho (*O*. *kisutch*), Lower Columbia River steelhead, and Middle Columbia River steelhead. These listings further provide an indication of the currently impaired habitat conditions that exist in a number of areas of the Coastal RU and of the impact to bull trout in relation to their available preybase. In fact, many of the actions necessary for salmon and steelhead recovery are consistent with or further support bull trout recovery, and in some cases vice versa. This is not unexpected given these species have coevolved within the same watersheds and bull trout utilized salmon as a significant part of their preybase, so their recovery is often integrally linked to one another within the Coastal RU. Furthermore, these listings and their related recovery planning efforts provide opportunities with respect to efficiencies and collaboration among numerous recovery partners to restore these ecosystems and the salmonids that inhabit them.

Current Status of Bull Trout in the Coastal Recovery Unit

The current demographic status of bull trout in the Coastal RU is variable across the unit. Populations in the Puget Sound region generally tend to have better demographic status, followed by the Olympic Peninsula, and finally the Lower Columbia River region. However, population strongholds do exist across the three regions. The Lower Skagit River and Upper Skagit River core areas in the Puget Sound region likely contain two of the most abundant bull trout populations with some of the most intact habitat within this recovery unit. The Lower Deschutes River core area in the Lower Columbia River region also contains a very abundant bull trout population and has been used as a donor stock for re-establishing other populations in the Lower Columbia River region of the recovery unit.

Puget Sound Region

In the Puget Sound region, bull trout populations are concentrated along the eastern side of Puget Sound with most core areas concentrated in central and northern Puget Sound. Although the Chilliwack River core area is considered part of this region, it is technically connected to the Fraser River system and is transboundary with British Columbia making its

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

Olympic Peninsula Region

In the Olympic Peninsula region, distribution of core areas is somewhat disjunct, with only one located on the west side of Hood Canal on the eastern side of the peninsula, two along the Strait of Juan de Fuca on the northern side of the peninsula, and three along the Pacific Coast on the western side of the peninsula. Most core areas support a mix of anadromous and fluvial life history forms, with at least one core area also supporting a natural adfluvial life history (Quinault River core area [Quinault Lake]). Demographic status of core areas is poorest in Hood Canal and Strait of Juan de Fuca, while core areas along the Pacific Coast of Washington likely have the best demographic status in this region. The connectivity between core areas in these disjunct regions is believed to be naturally low due to the geographic distance between them. Internal connectivity is currently poor within the Skokomish River core area (Hood Canal) and is being restored in the Elwha River core area (Strait of Juan de Fuca). Most core areas in this region still have their headwater habitats within relatively protected areas (Olympic National Park and wilderness areas).

Lower Columbia River Region

In the Lower Columbia River region, the majority of core areas are distributed along the Cascade Crest on the Oregon side of the Columbia River. Only two of the seven core areas in this region are in Washington. Most core areas in the region historically supported a fluvial life history form, but many are now adfluvial due to reservoir construction. However, there is at least one core area supporting a natural adfluvial life history (Odell Lake) and one supporting a

natural, isolated, resident[4] life history (Klickitat River [West Fork Klickitat]). Status is highly variable across this region, with one relative stronghold (Lower Deschutes core area) existing on the Oregon side of the Columbia River. The Lower Columbia River region also contains four watersheds (North Santiam River, South Santiam River, Upper Deschutes River, and White Salmon River) that could potentially become re-established core areas within the Coastal Recovery Unit. Adult abundances within the majority of core areas in this region are relatively low, generally 300 or fewer individuals.

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

Factors Affecting Bull Trout in the Coastal Recovery Unit

Watersheds within the Coastal Recovery Unit should be managed to maintain a diversity of bull trout life history types with stable or increasing population abundance. This will require appropriate management of primary threats (Table A-1), especially within key core areas to ensure diverse life histories continue to be expressed across the recovery unit. Recovery efforts should focus on conserving bull trout in each of the major geographic regions (Puget Sound, Olympic Peninsula, and Lower Columbia River) within the recovery unit. This will be essential for providing and maintaining adequate redundancy, representation, and resiliency of bull trout populations across the Coastal Recovery Unit.

Conservation efforts in the transboundary Chilliwack River and Upper Skagit River core areas should be planned in coordination with the British Columbia provincial government to effectively address threats associated with fisheries management, forestry practices, and mining development in these core areas.

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

Habitat Threats

Puget Sound Region

All core areas containing the anadromous bull trout life history form are reliant on access to marine and estuarine FMO habitats (Goetz *et al*. 2004; Hayes *et al*. 2011), so restoration of impaired and protection of functioning estuarine and nearshore marine habitats is considered a critical component of bull trout recovery in this region. Although specific studies examining the impacts of this degradation to bull trout are lacking, nearshore ecosystem impacts, impacts to salmonids in general, and impacts to bull trout prey species are clear. This degradation significantly impacts habitats not only required by anadromous bull trout, but also their key prey species (*e.g.*, juvenile salmon, surf smelt, sandlance, herring) (Shipman *et al*. 2010; Fresh *et al*. 2011). In 2000, it was estimated that one third of Puget Sound's shoreline had been modified, with over half of the main basin of Puget Sound having been altered (PSWQAT 2000). Although efforts to remove armoring have since been implemented, overall shoreline armoring continues to increase in Puget Sound (PSP 2013). Nearly 100 percent of the Duwamish estuary and Elliott Bay shoreline has been modified by some type of armoring (BMSL *et al*. 2001). Over 98 percent of the historic intertidal and subtidal habitat in Commencement Bay is reported to have been lost (WSCC 1999). In areas where nearshore habitats currently remain intact or only partially modified, development continues to threaten these habitats (PSP 2013). Specific recovery actions in the Puget Sound region may include removing or modifying artificial structures such as bulkheads, riprap, dikes, and tide gates; restoring tidal flow to coastal wetlands; contaminant remediation; or restoring eelgrass beds, kelp beds, and other nearshore habitats or processes.

Throughout Puget Sound, development and related impacts (*e.g.*, flood control, flood plain disconnection, bank armoring, channel straightening, loss of instream habitat complexity) along mainstem river corridors are common. Some of the most complex and costly restoration actions will be required to restore more natural features and functions to these areas. Although the impacts of agriculture, residential development, and urbanization are not currently believed to pose a primary threat to migratory bull trout using the lower Chilliwack River and lower Fraser River, conservation actions that address these activities should continue to be implemented in these areas as these river reaches are key migration corridors for the continued expression of the anadromous life history form.

Several core areas continue to be impacted by past forest management practices (harvest and roads). Since the time of listing, these impacts have and are anticipated to continue to decline as new forest management practices and restoration actions are implemented. One core area (Chester Morse Lake) in this region has no primary habitat threats to bull trout.

Table A-1. Primary Threats for the Coastal Recovery Unit (by Core Area and Shared FMO).

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Puget Sound Geographic Region				
Chilliwack River*	**3(7)**	**Upland/Riparian Land Management** (1.1) Forest Management – legacy and ongoing degradation of habitat and water quality in spawning and rearing tributaries outside of designated protected areas; coordinate with British Columbia	None	None
Nooksack River	**10**	**Upland/Riparian Land Management** (1.1) Legacy Forest Management and Agriculture Practices – associated impacts have led to channelization and habitat degradation within lower river FMO habitats, key to the persistence of the anadromous life history form **Water Quality** (1.3) Climate Change – seasonal high water temperatures in the South Fork Nooksack River are expected to be exacerbated, likely impairing migration, especially of the anadromous life history form, and reducing available spawning and rearing	**Connectivity Impairment** (1.1) Fish Passage Issues – Bellingham Water Diversion on Middle Fork Nooksack continues to limit access by the migratory life history form to habitats above the diversion and impairs connectivity between the Lower and Upper Middle Fork local populations	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
		habitat for South Fork Nooksack local populations		
Lower Skagit River	**20**	**Instream Impacts** (1.2) Flood Control – flood and erosion control associated with agricultural practices, residential development and urbanization continues to result in poor structural complexity within lower river FMO habitats (*e.g.*, Skagit and Suiattle Rivers) key to the persistence of the anadromous life history form **Water Quality** (1.3) Agriculture Practices and Residential Development and Urbanization – related activities have resulted in sediment and temperature impairment in major tributaries to the lower Skagit River and possibly upper Sauk River Climate Change – increasing variability in flows (higher peak and lower base flows) are anticipated to significantly impact both spatial and life history diversity of bull trout within the core area	**Connectivity Impairment** (1.1) Fish Passage Issues – upstream and downstream connectivity at hydropower facilities [Baker River hydropower project] is directly tied to active fish passage measures under FERC agreements	None

<u>**Geographic Region**</u> **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Upper Skagit River*	**9(6)**	**Upland/Riparian Land Management** (1.1) <u>Forest Management</u> – legacy and ongoing degradation of habitat and water quality in spawning and rearing tributaries outside of designated protected areas; coordinate with British Columbia **Instream Impacts** (1.2) <u>Recreational Mining</u> –activities impact spawning and rearing tributary habitats **Water Quality** (1.3) <u>Mining</u> – legacy impacts from Silver Daisy Mine in upper Skagit River, potential contaminants and downstream impacts associated with proposed Imperial Metals Giant Copper mine in upper Skagit River and Ross Lake, legacy and current impacts from mining in Ruby Creek watershed; coordinate with British Columbia	**Connectivity Impairment** (1.1) <u>Fish Passage Issues</u>– upstream and downstream connectivity at hydropower facilities [Skagit River projects] is currently not tied to any measures under the current FERC agreement. Recent genetic analyses indicate local populations in both Gorge and Diablo Reservoirs should be grouped with the Upper Skagit River local populations	**Nonnative Fishes** (3.1) <u>Hybridization</u> – increasing risk of brook trout hybridization due to population expansion and increase in fish size as a result of redside shiner introduction; coordinate with British Columbia

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Stillaguamish River	**3**	**Upland/Riparian Land Management** (1.1) Forest Management – legacy and ongoing impacts have exacerbated landslide activity in the watershed degrading salmonid habitat and water quality **Instream Impacts** (1.2) Recreational Mining –activities impact spawning and rearing tributary habitats **Water Quality** (1.3) Forest Management, Residential Development and Urbanization – legacy impacts result in seasonal high water temperatures in mainstem river, North and South Forks, and some local population tributaries; anticipated to be further exacerbated by climate change	**Connectivity Impairment** (1.1) Fish Passage Issues – Stillaguamish weir on Cook Slough impedes upstream fish passage and/or traps migratory spawners Fish Passage Issues – persistence of the migratory life history in the South Fork Stillaguamish River local population is reliant upon continued functionality of the fishway at Granite Falls) **Small Population Size** (2.3) Genetic and Demographic Stochasticity – available spawner abundance data indicates the low number of adults results in increased genetic and demographic stochasticity in the South Fork Stillaguamish and Upper Deer Creek local populations, in fact, the Upper Deer Creek local population may be extirpated)	None
Snohomish and Skykomish Rivers	**4**	**Instream Impacts** (1.2) Flood Control – flood and erosion control associated with agricultural practices, residential development and urbanization continues to result	**Connectivity Impairment** (1.1) Fish Passage Issues – persistence of the South Fork Skykomish River local population is reliant upon	None

<u>Geographic Region</u> **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
		in poor structural complexity within lower river FMO habitats key to the persistence of the anadromous life history form <u>Recreational Mining</u> –activities impact spawning and rearing tributary habitats **Water Quality** (1.3) <u>Residential Development and Urbanization</u> – associated impacts increase seasonal high water temperature in lower mainstem river, a migration corridor key to the persistence of the anadromous life history form	ongoing operation of the trap and haul facility at Sunset Falls)	
Chester Morse Lake	**4**	None	**Connectivity Impairment** (1.1) <u>Fish Passage Issues</u> – migration between the lake and tributary spawning habitats is tied directly to ongoing reservoir operations. Any significant changes to current reservoir operating regimes could impact migration and availability of their primary forage fish, pygmy whitefish; anticipated to be further exacerbated by climate change	None

<u>**Geographic Region**</u> **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Puyallup River	**4**	**Upland/Riparian Land Management** (1.1) <u>Legacy Forest Management Practices</u> – significant impacts in mid-elevation areas outside of Mount Rainier National Park, especially within the Upper Puyallup and Mowich Rivers local population **Instream Impacts** (1.2) <u>Flood Control</u> – flood and erosion control associated with residential development and urbanization continues to result in poor structural complexity within lower river FMO habitats key to the persistence of the anadromous life history form <u>Climate Change</u> – increases in glacial outbursts and channel widening is reducing access to available spawning tributaries and negatively impacting spawning habitats	**Connectivity Impairment** (1.1) <u>Fish Passage Issues</u> – Buckley Diversion/Mud Mountain Dam isolates local populations and/or delays migrations; low flows in bypass reaches can limit habitat availability and migration) <u>Entrainment</u> – Electron Dam isolates local populations, delays migrations and/or entrain individuals; low flows in bypass reaches can limit habitat availability and migration **Small Population Size** (2.3) <u>Genetic and Demographic Stochasticity</u> – available spawner abundance data indicates the low number of adults results in increased genetic and demographic stochasticity in the Upper Puyallup and Mowich Rivers local population	**Nonnative Fishes** (3.1) <u>Hybridization</u> – presence of brook trout pose significant risk of hybridization in the Carbon River local population which is largely composed of the resident life history; brook trout also detected in spawning and rearing areas within other parts of the core area, which may pose hybridization risk, although to a lesser extent, in other local populations

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Puget Sound Marine (also includes small independent streams – *i.e.*, Dakota, Whatcom and Squalicum Creeks)	**n/a**	**Upland/Riparian Land Management** (1.1) Residential Development and Urbanization – ongoing impacts degrade or eliminate nearshore marine and estuarine habitats and processes critical to the persistence of the anadromous life history form and their marine prey base	None	None
Samish River	**n/a**	None	None	None
Lake Washington	**n/a**	None	**Connectivity Impairment** (1.1) Temperature Barriers – seasonal temperature limitations in Ship Canal	None
Lower Green River	**n/a**	None	**Forage Fish Availability** (2.4) Preybase – depressed populations of salmon and steelhead significantly limits the available freshwater preybase in this system	None
Lower Nisqually River	**n/a**	None	None	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Olympic Peninsula Geographic Region				
Dungeness River	**2**	**Instream Impacts** (1.2) Flood Control – flood and erosion control associated with agricultural and residential development continues to result in poor structural complexity and high water temperatures within the lower river, a migration corridor key to the persistence of the anadromous life history form. Floodplain restoration, large wood recovery, and riparian conservation are critical needs **Water Quality** (1.3) Altered Flows – agricultural and residential water use continues to result in poor instream flow and dewatering within the lower Dungeness River impairing FMO habitat	**Small Population Size** (2.3) Genetic and Demographic Stochasticity – available spawner abundance data indicates the low number of adults results in increased genetic and demographic stochasticity in both the Dungeness River and Grey Wolf River local populations **Forage Fish Availability** (2.4) Preybase – depressed populations of salmon and steelhead limits the available freshwater preybase within this system even though abundance of some species [*i.e.*, pink salmon] has significantly improved	None
Elwha River	**2**	**Instream Impacts** (1.2) Fish Passage Issues – fish passage difficulty at former dam sites **Water Quality** (1.3) Instream Flows – adequate water quantity within the lower river will need to be maintained	**Forage Fish Availability** (2.4) Preybase – although dam removal has been completed, salmon and steelhead populations are only in the early rebuilding phase and may require additional habitat and/or fish management intervention to fully restore freshwater	**Nonnative Fishes** (3.1) Competition and Hybridization – brook trout now overlap tributary spawning areas for bull trout in Indian, Griff, and Hughes creeks, and Little River, creating significant potential for species competition and hybridization; additional

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
		into the future, as municipal water rights currently exceed summer flows. Exercising full water rights will seasonally alter instream habitat and impair connectivity for migration; ongoing loss of glaciers associated with climate change is expected to exacerbate low instream flows	preybase in this system	concern with potential upstream expansion following dam removal
Hoh River	**2**	**Upland/Riparian Land Management** (1.1) Transportation Networks – improved roads paralleling the river continue to impact habitat within stream corridors through loss of riparian areas, bank stability efforts, channel simplification of FMO habitat, and altered tributary connectivity	**Fisheries Management** (2.2) Angling or Harvest – incidental catch from other fisheries has been amplified by regional salmon and steelhead ESA-listings that have shifted regional recreational angling effort to coastal streams	None
Queets River	**1**	**Upland/Riparian Land Management** (1.1) Forest Road System – the system in parts of the watershed require ongoing maintenance and stabilization to limit stream associated impacts)	**Fisheries Management** (2.2) Angling or Harvest – incidental catch has been amplified by regional salmon and steelhead ESA-listings that have shifted regional recreational angling effort to coastal streams; and has been demonstrated to be significant in some Tribal fisheries	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Quinault River	**2**	**Upland/Riparian Land Management** (1.1) Transportation Networks – improved roads paralleling the river continue to impact habitat within stream corridors through loss of riparian areas, bank stability efforts, channel simplification of FMO habitat, and altered tributary connectivity Loss of Channel Complexity – land management impacts have altered Middle Reach which was historically a key spawning area for sockeye and migratory reach for adfluvial bull trout. This reach is growing highly unstable due to land management impacts	**Fisheries Management** (2.2) Angling or Harvest – incidental catch has been amplified by regional salmon and steelhead ESA-listings that have shifted regional recreational angling effort to coastal streams; and has been demonstrated to be significant in some Tribal fisheries	None
Skokomish River	**2**	**Upland/Riparian Land Management** (1.1) Legacy Forest Management and Roads –South Fork Skokomish River system is still undergoing recovery with additional restoration efforts required to address further contribution to habitat degradation and channel aggradation **Instream Impacts** (1.2) Flood Control – South Fork	**Connectivity Impairment** (1.1) Fish Passage Issues – incomplete passage efforts at Cushman Dams on North Fork Skokomish River currently constrain migration and limit connectivity of local populations; while aggraded reaches in the mainstem and South Fork Skokomish Rivers and canyon reaches in upper South Fork Skokomish River	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
		Skokomish River continues to aggrade due to past removal of large woody debris and bank protection measures. This has resulted in a highly simplified stream channel lacking habitat complexity critical for supporting fish	can seasonally impair migration of fluvial and anadromous life history forms. South Fork conditions are likely to be further exacerbated by climate change **Fisheries Management** (2.2) Angling or Harvest – incidental catch from other fisheries in mainstem and South Fork Skokomish River put the South Fork Skokomish local population at increased risk due to its small population size and the timing of fisheries **Small Population Size** (2.3) Genetic and Demographic Stochasticity – available spawner abundance data indicates the low number of adults results in increased genetic and demographic stochasticity in the South Fork Skokomish local population **Forage Fish Availability** (2.4) Preybase – depressed populations of salmon/steelhead primarily in the South Fork Skokomish River limits productivity within this local population	

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Strait of Juan de Fuca (also includes small independent streams – Siebert, Morse, Ennis, and Valley Creeks)	**n/a**	**Upland/Riparian Land Management** (1.1) Residential Development and Urbanization – loss of the Dungeness River paleo-estuarine delta at Graysmarsh has reduced functioning habitat for anadromous life history. Conservation of drift cell processes is crucial for maintaining essential accretionary landforms, especially Dungeness Spit and the six spits and embayments associated with Washington Harbor and Sequim Bay.	None	None
Pacific Coast (also includes small independent streams – Goodman, Mosquito, Cedar, Steamboat, Kalaloch, and Joe Creeks; Raft, Moclips, and Copalis Rivers)	**n/a**	**Upland/Riparian Land Management** (1.1) Forest Management – associated impacts cause degradation to a number of small, nonnatal, independent streams and their estuaries that are essential for overwintering and foraging by the anadromous life history form	None	None
Chehalis River/Grays Harbor	**n/a**	None	None	None
Hood Canal Marine	**n/a**	None	None	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Lower Columbia River Geographic Region				
Lewis River	**3**	**Upland/Riparian Land Management** (1.1) Natural Event – Mount St. Helens eruption in 1980 has resulted in persistent adverse impacts to hillslope processes, stream corridor structure and function, and channel structure and stability Forest Practices – past timber harvest practices on Federal land have adversely impacted hillslope processes; timber harvest practices on private land adversely impacts hillslope processes Transportation – road system in forested land adversely impacts hillslope processes and access to productive habitat **Instream Impacts** (1.2) Entrainment – current facility operations reduce juvenile to adult survival rates **Water Quality** (1.3) Residential and Recreational Development – adversely	**Connectivity Impairment** (1.1) Fish Passage Issues – the system of dams on the mainstem Lewis River limits genetic exchange between local populations and suppresses opportunity for expression of the anadromous life history) Limited Extent of Habitat – degraded watershed processes limit extent of habitat quantity and quality available for bull trout spawning **Fisheries Management** (2.2) Angling or Harvest – Release mortalities and illegal retention of bull trout in fisheries targeting other species reduces population abundance and productivity **Small Population Size** (2.3) Genetic and Demographic Stochasticity – Current low abundance levels limit the effective breeding population size, which adversely impacts population productivity through	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
		impacts hillslope processes and stream corridor structure and function Climate Change – predicted changes expected to adversely impact hillslope process, water temperature, and instream flows in the basin	potential inbreeding and genetic drift	
Klickitat River	**1**	None	None	**Nonnative Fishes** (3.1) Hybridization and Competition – presence of brook trout pose significant risk of hybridization in the West Fork Klickitat River local population which is composed of the resident life history
Hood River	**2**	**Upland/Riparian Land Management** (1.1) Legacy Forest Management and Agriculture Practices – impacts from these activities have resulted in channelization and habitat degradation **Instream Impacts** (1.2) Water Management – water withdrawal at irrigation dams and diversions decrease flow, and alter sediment and wood routing) **Water Quality** (1.3) Water Management –	**Connectivity Impairment** (1.1) Fish Passage Issues – impeded fish passage at Clear Branch Dam isolates a population of bull trout above the dam; Low flow conditions prevent migration during summer and fall	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
		operations at Clear Branch Dam increase downstream water temperatures)		
Lower Deschutes River	**5**	None	None	None
Upper Willamette River	**4**	**Upland/Riparian Land Management** (1.1) Forest Management Practices – legacy forest management practices have degraded instream and riparian habitats) **Instream Impacts** (1.2) Altered Flows and Geomorphic Processes – operation of the major dams alters the natural flow regime and geomorphic processes, eliminating pools and complex habitat suitable for juvenile and adult rearing)	**Connectivity Impairment** (1.1) Entrainment and Fish Passage Issues – dams entrain fish, impede passage, cause passage related mortality and isolate what was once one population into four small populations **Fisheries Management** (2.2) Illegal Harvest – illegal harvest and incidental angling-related mortality are significant sources of take in the McKenzie River and Middle Fork Willamette River [Hills Creek Reservoir] **Forage Fish Availability** (2.4) Preybase – loss of anadromous fish due to fish passage issues at dams impact forage base and productivity of bull trout	None

Geographic Region **Core Area – Complex** ***Core Area – Simple*** Shared FMO	**Number of Local Populations (additional LPs in Canada)**	**PRIMARY THREATS[1]**		
		Habitat	***Demographic***	***Nonnatives***
Odell Lake	**1**	**Instream Impacts** (1.2) Transportation Networks – legacy effects related to transportation networks (railroad grade) degraded and limited spawning habitat in Odell Lake tributaries	**Fisheries Management** (2.2) Angling – incidental catch from the kokanee and lake trout fisheries impact a significant portion of the estimated bull trout population **Small Population Size** (2.3) Genetic and Demographic Stochasticity – available spawner abundance data indicates Odell Lake bull trout are at risk of genetic and demographic stochasticity. Redd counts over the last generation average less than 12 redds	**Nonnative Fishes** (3.1) Predation/Species Competition – nonnative lake trout likely negatively impact bull trout Hybridization/Species Competition – nonnative brook trout hybridize with bull trout and compete for food and space
Clackamas	**Recently reintroduced (2011)**	None	None	None
Lower Columbia River Mainstem	**n/a**	None	None	None

***Transboundary core area – coordinate with British Columbia, Canada.**

[1] **Primary Threat**: *Factors known or likely (i.e., non-speculative) to negatively impact bull trout populations at the core area level, and accordingly require actions to assure bull trout persistence to a degree necessary that bull trout will not be at risk of extirpation within that core area in the foreseeable future (4 to 10 bull trout generations, approximately 50 years).*

Olympic Peninsula Region

As in the Puget Sound Region, all core areas containing the anadromous life history form are reliant on access to marine and estuarine FMO habitats, so restoration of impaired and protection of functioning estuarine and nearshore marine habitats is considered a critical component of bull trout recovery in this region. Specific recovery actions in the Olympic Peninsula Region may include removing or modifying artificial structures such as bulkheads, riprap, and dikes; restoring tidal flow to coastal wetlands; or restoring eelgrass beds, kelp beds, and other nearshore habitats or processes.

Development and related impacts (*e.g.*, flood control, flood plain disconnection, bank armoring, channel straightening, and loss of instream habitat complexity) along mainstem river corridors are most common in the Dungeness River core area and to some extent in parts of the Quinault River core area. Transportation networks, both improved roads and forest roads have had significant impacts to a number of core areas in this region. Most prominent impacts are related to stream-adjacent roads that have direct impacts to stream banks and channels as these roads periodically fail and are maintained or reconstructed. In the Skokomish River core area, an extensive history of road building and intense timber harvest has resulted in significant aggradation of the South Fork and mainstem Skokomish Rivers, key migratory corridors for bull trout. Similar to the Puget Sound region, some of the most complex and costly restoration actions will be required to restore more natural features and functions to these mainstem river areas.

In three core areas (Dungeness River, Elwha River, and Skokomish River), instream flows or aggraded channels have seasonal impacts that threaten connectivity between spawning and rearing habitats and foraging migration and overwintering habitats.

Lower Columbia River Region

Ongoing habitat threats related to dams are present in three core areas (Lewis River, Hood River, and Upper Willamette River) within this region. Dams have hampered natural fluvial processes such as wood routing and sediment transport, resulting in oversimplified mainstem reaches that are lacking pools and instream channel complexity. They have also resulted in entrainment and changes in temperature regimes.

Habitat threats from residential development, transportation systems, and forest practices affect four core areas in this region. Spawning and rearing habitats and migratory corridors continue to be degraded from a range of related impacts such as sedimentation, channel instability, channel simplification, reduced instream flows, and increases in water temperature. The Lewis River core area has a key local population that also continues to recover from

persistent adverse impacts from the eruption of Mount St. Helens, principally simplified channel structure and channel instability.

Three core areas (Klickitat River, Lower Deschutes River, and Clackamas River) in this region have no primary habitat threats to bull trout.

Demographic Threats

Puget Sound Region

Ongoing population connectivity impairment is present in three core areas (Nooksack River, Puyallup River, and Upper Skagit River) within this region, with another four core areas (Lower Skagit River, Stillaguamish River, Snohomish and Skykomish Rivers, and Chester Morse Lake) requiring ongoing efforts (*e.g.*, Federal Energy Regulatory Commission [FERC] implementation, habitat conservation plan [HCP] implementation, maintenance of trap and haul or fishway operations) to maintain existing population connectivity.

Two core areas (Stillaguamish River and Puyallup River) are currently affected by small population sizes in a significant part (important local population) or all of the core area (Stillaguamish River). No core areas in this region are believed to be significantly threatened by current fisheries management; however, due to their anadromous life history strategy, age structure, susceptibility to angling and potential interception by some net fisheries, any changes in fisheries management should continue to be monitored for their population impacts. Although no core area in this region is believed to be threatened by a lack of current freshwater forage fish availability, one shared FMO (Lower Green River) currently has a limited freshwater preybase for anadromous bull trout. In contrast, no core areas in this region are believed to be significantly threatened by current levels of marine forage fish availability; however, the protection and restoration of nearshore marine habitats will be necessary to maintain and increase this forage fish availability for bull trout.

Olympic Peninsula Region

Population connectivity impairment threatens only one core area (Skokomish River) within this region. Over half of the core areas in this region are believed to be affected by fisheries management impacts. Two core areas (Dungeness River and Skokomish River) in this region are currently affected by small population sizes in a significant part (important local population) or all of the core area (Dungeness River). Half of the core areas (Dungeness River, Elwha River, and Skokomish River) in this region are currently affected by a reduction in forage base (anadromous salmon). These affected basins all have federally listed populations of salmon (Puget Sound chinook, Hood Canal summer chum) and steelhead (Puget Sound steelhead) that are in various phases of recovery. In contrast, no core areas in this region are believed to be

significantly threatened by current levels of marine forage fish availability; however, the protection and restoration of nearshore marine habitats will be necessary to maintain and increase this forage fish availability for anadromous bull trout.

Lower Columbia River Region

Inter-population connectivity impairment threatens two core areas (Hood River and Upper Willamette River) within this region. What were likely single, connected local populations within these two core areas have been fragmented and isolated. In the Lewis River core area, connectivity impairment from dams limits genetic exchange between local populations and the opportunity for the expression of the anadromous life history form. Dams have also limited the quantity and quality of available spawning habitat in this core area.

Three core areas (Lewis River, Upper Willamette River, and Odell Lake) in this region are affected by fisheries management impacts either through incidental catch and/or illegal harvest. This may be particularly significant in the Odell Lake core area, where recent creel data estimated 18 percent of the bull trout population was incidentally captured and released in a angling season (ODFW, unpublished data 2014). Two core areas (Lewis River and Odell Lake) in this region are currently affected by small population size in a significant part (important local population) or all of the core area (Odell Lake). One core area (Upper Willamette River) in this region is believed to be threatened by current freshwater forage fish availability.

Three core areas (Klickitat River, Lower Deschutes River, and Clackamas River) in this region have no primary demographic threats to bull trout.

Nonnative Fish Threats

Puget Sound Region

Two core areas (Upper Skagit River and Puyallup River) in this region are believed to be threatened by nonnative fish (brook trout) in this region. Although current brook trout distribution is limited within these two core areas, there are significant areas/portions of overlap with bull trout, hybrids have been detected, and their continued increase in overall abundance seems likely without active management. There is one other core area within this region where brook trout may be a concern due to their wide distribution and overlap with key bull trout local population areas; however, they are not considered a primary threat at this time due to uncertainty about their direct interaction with migratory life history forms of bull trout.

Olympic Peninsula Region

One core area (Elwha River) in this region is threatened by nonnative fish (brook trout). Although current brook trout distribution is limited within the core area, there are significant

areas of overlap and with recent completion of dam removal their expansion in distribution and abundance seems likely without active management.

Lower Columbia River Region

Two core areas (Klickitat River and Odell Lake) in this region are threatened by nonnative fish (lake trout and brook trout). Although brook trout in at least one other core area (Lewis River) within this region have been identified as a concern, they are not considered a primary threat at this time due to their limited distribution, current low rates of hybridization, or current uncertainty about their direct interaction with migratory life history forms of bull trout.

Climate Change

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

Patterns consistent with changes in climate have already been observed in the range of many species and in a wide range of environmental trends (ISAB 2007; Hari *et al*. 2006; Rieman *et al*. 2007). In the northern hemisphere, the duration of ice cover over lakes and rivers has decreased by almost 20 days since the mid-1800's (WWF 2003). The range of many species has shifted poleward and elevationally upward. For cold-water associated salmonids in mountainous regions, where their upper distribution is often limited by impassable barriers, an upward thermal shift in suitable habitat can result in a reduction in range, which in turn can lead to a population decline (Hari *et al*. 2006).

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

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

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

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

Migratory bull trout can be found in lakes, large rivers, and marine waters. Effects of climate change on lakes are likely to impact migratory adfluvial bull trout that seasonally rely upon lakes for their greater availability of prey and access to tributaries. Climate-warming impacts to lakes will likely lead to longer periods of thermal stratification and coldwater fish such as adfluvial bull trout will be restricted to these bottom layers for greater periods of time. Deeper thermoclines resulting from climate change may further reduce the area of suitable temperatures in the bottom layers and intensify competition for food (WWF 2003).

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

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

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

In the Puget Sound region, Battin *et al*. (2007) used a series of linked models of climate, land cover, hydrology, and salmon population dynamics to investigate the impacts of climate change on Chinook salmon habitats within the Snohomish River Basin. Their model results project negative impacts from climate change will be most pronounced in relatively pristine, high-elevation streams in this system. These impacts include higher water temperatures, lower spawning flows, and, most importantly, increased magnitude of winter peak flows within the Snohomish River Basin and in hydrologically similar watersheds throughout the region (Battin *et al*. 2007). Although the ultimate impact of climate change on bull trout populations in the Puget Sound region remains uncertain, these results indicate that bull trout spawning and rearing areas are particularly vulnerable to future climate change impacts, especially due to the narrow distribution of spawning sites within this and other similar systems. In addition, glacial outburst floods believed to be caused by climate change have negatively impacted known tributary spawning sites in the Puyallup River core area (B. Wright, Mount Rainier National Park, *in litt*. 2015a). To account for this ongoing impact and/or loss of spawning habitat, the development of mitigation strategies will be required.

Output scenarios from the recent Climate Shield model by Isaak *et al*. (2015) indicate that the Stillaguamish River, Snohomish and Skykomish Rivers, and Chester Morse Lake core areas may be the least likely within the Puget Sound region to have persistent cold water remaining to support juvenile bull trout by 2040 (Isaak *et al*. 2015). The model predicts peak summer temperatures in watersheds throughout the range of the bull trout. The Climate Shield model couples nearly 30,000 crowd-sourced summer water temperature measurements from a diverse array of agencies and institutions across over 10,000 unique stream locations to mathematically assess stream temperatures and forecast future scenarios (Isaak *et al*. 2015). By

analyzing these scenarios, high-resolution networks of cold water refugia can be predicted and evaluated.

Associated sea-level rise is also anticipated to exacerbate already impacted marine shorelines of Puget Sound. Responses to sea-level rise are expected to include additional shoreline protection efforts to maintain urban and residential infrastructure.

In the Olympic Peninsula region, although the ultimate impact of climate change on bull trout populations remains uncertain, significant and accelerating glacial retreat in the Olympic Mountains and related declines in the glacial contribution to summer streamflow strongly indicate the continued loss of glaciers will directly impact stream habitats in bull trout core areas through higher stream temperatures and lower summer base flows (Riedel *et al*. 2015). As in the Puget Sound region, anticipated responses to sea-level rise are expected to further degrade critical marine nearshore habitats.

Output scenarios from the recent Climate Shield model by Isaak *et al*. (2015) indicate that the Quinault River and Skokomish River core areas may be the least likely within the Olympic Peninsula region to have persistent cold water remaining to support juvenile bull trout by 2040 (Isaak *et al*. 2015).

In the Lower Columbia River region, output scenarios from the recent Climate Shield model by Isaak *et al*. (2015) indicate that, although there will likely be significant reductions in cold water for most core areas, which could lead to local extirpation of some local populations, some cold water areas will persist within all core areas to support juvenile bull trout by 2040 (Isaak *et al*. 2015).

Ongoing Coastal Recovery Unit Conservation Measures (Summary)

Since the listing of bull trout, numerous conservation measures have been and continue to be implemented within the Coastal Recovery Unit. These measures are being undertaken by a wide variety of local and regional partnerships, including State fish and game agencies, State and Federal land management and water resource agencies, Tribal governments, power companies, watershed working groups, water users, ranchers, and landowners. In many cases these bull trout conservation measures incorporate or are closely interrelated with work being done for recovery or restoration of salmon and steelhead populations, which are limited by many of the same threats. Ongoing interagency recovery planning and implementation efforts for federally listed salmon populations should complement bull trout recovery in the Coastal Recovery Unit where the listed species' ranges overlap. Generally, salmon recovery actions also function to improve habitat for bull trout; often spawning and rearing habitat for salmon and steelhead is concurrently used as FMO habitat by bull trout. Moreover, the restoration of Chinook and steelhead, as well

as other salmon runs in the Coastal Recovery Unit, also benefits bull trout by providing eggs and juvenile salmonids as forage items.

Some of the most significant conservation measures for bull trout that have been implemented since the listing are related to dam relicensing. FERC relicensing of major hydropower facilities in this recovery unit has provided opportunities for development of upstream and downstream fish passage or for complete dam removal (Elwha and Glines Canyon dams on Elwha River, Conduit Dam on White Salmon River, and Powerdale Dam on Hood River) at a number of formerly impassible sites.

Additionally, there are ongoing efforts through the process of land acquisition to permanently conserve bull trout habitat within the recovery unit. For example, in western Washington over 8,000 acres (3,200 hectares) of habitat essential to bull trout recovery have been permanently conserved through the assistance of the USFWS's non-traditional Section 6 Land Acquisition Grant program. Since 2003, the Western Rivers Conservancy has purchased over 7,000 acres (2,800 hectares) along the Hoh River (Hoh River core area) with the objective of creating a 30-mile (50-km) long conservation corridor from the interior of the Olympic National Park to the Pacific Coast. This land, which is now owned by the Hoh River Trust, will be managed to improve and restore habitat for listed species, including bull trout. In 2005, Seattle City Light in cooperation with The Nature Conservancy purchased over 1,000 acres (400 hectares) in the Boulder Creek watershed (Lower Skagit River core area). One of the primary objectives of this purchase is to protect habitat for listed bull trout, Chinook salmon, and steelhead, and other sensitive aquatic species. Both these efforts have protected important aquatic, riparian, and associated upland habitats key to the recovery and long-term conservation of bull trout.

Puget Sound Region

Within this major geographic region, the recently completed regional salmon recovery plan under the Shared Strategy for Puget Sound and plan implementation by watersheds under the Puget Sound Partnership has resulted in general habitat improvements for bull trout. However, actions to date (*e.g.*, land acquisition, floodplain restoration, culvert removal, riparian revegetation, levee setbacks, and road removal) have generally been focused on Puget Sound Chinook salmon. The Washington Forest Practices HCP has provided additional fish habitat protections in forested upland habitats, with improved forestry practices and road maintenance (FFR 1999; WFPB 2001).

Within the Puyallup River core area, upstream passage was restored above Puget Sound Energy's Electron Dam in 2000, restoring connectivity for the bull trout populations in the upper Puyallup River that had largely been isolated above the dam from the rest of the basin's populations (White and Carbon Rivers) for nearly 100 years. Renewed passage is helping to facilitate reestablishment of migratory bull trout, especially the anadromous form, to the Puyallup River. Within the Lower Skagit River core area, Puget Sound Energy completed

significant upstream and downstream fish passage improvements in 2013 at the Baker River Dams (Puget Sound Energy, *in litt*. 2013), enhancing both population and habitat connectivity. Renewed passage is helping to maintain the expression of the anadromous life history form in the Baker River system.

On May 8, 2008, then-President Bush signed Wild Sky Wilderness into law. This law designated 106,577 acres (43,130 hectares) of national forest within the Snohomish and Skykomish Rivers core area as wilderness (P. Murray *in litt*. 2008). This recent designation expands existing habitat protections under other wilderness designation in the area (*i.e.*, Henry M. Jackson Wilderness Area). Much of the key spawning and rearing habitat for bull trout within the North Fork Skykomish River system will gain protection from this designation which protects thousands of acres of low-elevation old growth forest in addition to 25 miles (40 km) of salmon streams.

In addition, active, ongoing partnerships such as the Puget Sound Partnership (PSP 2014) and Puget Sound Nearshore Ecosystem Restoration Project, as well as the Service's own Coastal Land Acquisition program are contributing to bull trout recovery through identification and implementation of projects that protect and restore important nearshore marine FMO habitats used by bull trout or their preybase (*e.g.*, salmon, surf smelt, and herring) in this region.

Olympic Peninsula Region

For core areas connected to the Strait of Juan de Fuca and Hood Canal, the recently completed regional salmon recovery plan under the Shared Strategy for Puget Sound and plan implementation by watersheds under the Puget Sound Partnership has resulted in general habitat improvements for bull trout in core areas. However, actions to date (*e.g.*, land acquisition, floodplain restoration, culvert removal, riparian revegetation, levee setbacks, and road removal) have generally been focused on Puget Sound Chinook salmon. The Washington Forest Practices HCP has provided additional fish habitat protections in forested upland habitats, with improved forestry practices and road maintenance (FFR 1999; WFPB 2001).

Within the Elwha River core area, the Elwha and Glines Canyon Dams had blocked upstream anadromous salmonid access to 70 miles (113 km) of bull trout habitat on the Olympic Peninsula for nearly 100 years. In 2014, with the nearly completed removal of the Glines Canyon Dam, bull trout (potentially anadromous) began to return to the upper watershed with the reopening of migratory corridors and flushing of accumulated sediments (The News Tribune, *in litt*. 2014). The relicensing agreement with Tacoma Power for the Cushman Hydroelectric Project in 2010 (Skokomish River core area) is expected to significantly improve connectivity for upstream and downstream migrating bull trout as well as conserve important habitats for this species once license articles are fully implemented. In addition, the restoration of fish passage will reintroduce anadromous salmon into the upper North Fork Skokomish River Basin.

In addition, active, ongoing partnerships such as the Puget Sound Partnership (PSP 2014) and Puget Sound Nearshore Ecosystem Restoration Project, as well as the Service's own Coastal Land Acquisition program are contributing to bull trout recovery through identification and implementation of projects that protect and restore important nearshore marine FMO habitats used by bull trout or their preybase (*e.g.*, salmon, surf smelt, and herring) in this region.

Lower Columbia River Region

In 2011, the Service published a final rule in the Federal Register to establish a nonessential experimental population of bull trout in the Clackamas River and its tributaries in Clackamas County, Oregon under section 10(j) of the Act. Bull trout were extirpated from the Clackamas River basin in the early 1960s, and re-establishing bull trout in the Clackamas River basin will help achieve recovery goals within the Coastal Recovery Unit. Adult and juvenile bull trout were translocated from the Metolius River to the Clackamas River in 2011 and 2012, and the first spawning activity was observed in the fall of 2011. Additional translocations are planned to continue for several years. The Service and Oregon Department of Fish and Wildlife are conducting this project in coordination with the Mt. Hood National Forest, the Confederated Tribes of Warm Springs, Portland General Electric, NOAA Fisheries, and the U.S. Geological Survey (Shively *et al*. 2007; USFWS and ODFW 2011). The success of the recent reintroduction of bull trout in the Clackamas River basin in Oregon advances the potential for restoring bull trout in other historic core areas along the Lower Columbia River (*e.g.*, North Fork Santiam, South Fork Santiam, Upper Deschutes, and White Salmon River); re-establishing bull trout populations that have been extirpated may help meet recovery criteria in the Coastal Recovery Unit.

In the Upper Willamette River core area, a variety of habitat enhancements, fish screens, and passage improvements in the McKenzie River basin have been implemented by the Willamette National Forest, Oregon Department of Fish and Wildlife, and Eugene Water and Electric Board (EWEB). Under FERC relicensing, Trail Bridge Dam will have future upstream and downstream passage once EWEB receives their license. Bull trout from the McKenzie River have been introduced into the Middle Fork Willamette River to reestablish this population.

In the Hood River core area, bull trout conservation measures have included the decommissioning and removal of Powerdale Dam by PacifiCorp in coordination with Columbia River Land Trust and Hood River County (Hood River News *in litt.* 2013), various stream habitat improvements, and screening of the Coe Creek diversion by the Middle Fork Irrigation District.

Within the Lower Deschutes Core Area, the City of Prineville and seven primary irrigation districts that comprise the Deschutes Basin Board of Control are developing an HCP designed to conserve bull trout and their habitats (USFWS 2014b). When completed, the HCP

will benefit bull trout and other aquatic and riparian-dependent species while meeting current and future irrigation and municipal water needs.

Additionally, Portland General Electric (PGE) and the Confederated Tribes of Warm Springs, completed a fish collection facility in 2009 at Round Butte Dam to provide downstream fish passage for steelhead and salmon; this project also provides connectivity for bull trout between the upper and lower portions of the Deschutes core area. PGE, the Tribe, and local watershed conservation groups are also funding numerous supporting projects for stream habitat restoration in adjoining watersheds (*e.g.*, Metolius River, Crooked River, Trout Creek, Whychus Creek, and Shitike Creek) (CTWS and PGE 2015).

New fish passage facilities being constructed at the PacifiCorp Lewis River project (Lewis River core area) will collect and transport fish between Merwin Dam and Swift Dam, connecting 117 miles (188 km) of stream habitat (PacifiCorp *et al*. 2004). These facilities will eventually reduce entrainment and improve connectivity between local populations, and provide the opportunity for the expression of the anadromous life history form. In 2011, Conduit Dam was removed, which blocked upstream fish passage for nearly 100 years in the White Salmon River. The removal of this dam has provided the potential for natural recolonization of the watershed by bull trout.

Research, Monitoring, and Evaluation

A number of core areas throughout the Coastal Recovery Unit have one or more research, monitoring, or evaluation actions identified as necessary for recovery. Research, monitoring, and evaluation actions necessary for recovery are those deemed critical for developing information for planning, implementing, monitoring, and evaluating effectiveness of actions addressing management of primary threats.

Some form of annual or periodic monitoring of bull trout abundance or other sufficient demographic surrogate has been identified for all core areas to determine the effectiveness of identified recovery actions and/or their implementation in adequately addressing primary threats to the species that were identified in each core area. Other research or monitoring actions are focused on better establishing the current and/or ongoing degree of impact of a particular identified threat (*e.g.*, nonnatives and fisheries management) to particular core areas, to better target and be more efficient in the implementation of recovery actions. These various efforts will be conducted in coordination with our recovery partners, consistent with an adaptive management approach using feedback from implemented, site-specific recovery actions.

Recovery Measures Narrative

The recovery measures narrative for each core area within the Coastal Recovery Unit is structured in a hierarchical step-down narrative under which specific recovery actions are grouped and listed to address identified primary threats. The Service established three broad primary threat category classifications (habitat, demographic, and non-natives) which were further subdivided into more specific second tier threat categories where applicable:

Habitat – Upland/Riparian Land Management, Instream Impacts, and Water Quality

Demographic – Connectivity Impairment, Fisheries Management, Small Population Size, and Forage Fish Availability

Nonnatives – Nonnatives

Specific recovery actions are each listed under a third tier of individual threat descriptors which were developed to more specifically characterize these second tier threat categories for that particular core area. If a second tier threat category is not applicable to a particular core area, no third tier threats are listed in the narrative and the second tier threat is shaded gray. Core areas, shared FMOs, and their specific recovery actions have been grouped by the three major geographic regions.

A number of conservation recommendations have been identified for each core area in the Coastal Recovery Unit. Although these recommendations are not considered to be necessary to achieve recovery, they typically further our understanding of bull trout and other potential threats, or they further increase the overall conservation within core areas. Because a number of federally listed salmon and steelhead populations exist across the Coastal Recovery Unit, recovery actions targeted at these species either coincide with necessary actions identified for the recovery of bull trout or further complement ecosystem conditions that will help support bull trout, especially in foraging, migration, and overwintering habitats. Therefore, as a common conservation recommendation, we have identified implementing all recovery actions identified in salmon or steelhead recovery plans that overlap the distribution of bull trout core areas in this recovery unit.

Puget Sound Region

Chilliwack River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management

1.1.1 Provide adequate protection of spawning and rearing streams. Active timber harvest, road development and road maintenance in tributary basins below Chilliwack Lake (Tamihi Creek, Nesakwatch Creek, and Centre Creek) and tributaries to Chilliwack Lake (Depot Creek and Paleface Creek) continue to impact instream habitat (Jesson, B.C. Ministry of Forests, Lands and Natural Resource Operations, *in litt*. 2015). Implement riparian protections and road development practices that buffer or avoid impacts from ongoing forest development to protect spawning and rearing habitats.

1.1.2 Restore instream channel and riparian conditions. Conduct stream channel restoration activities where warranted and cost-effective. Legacy forest management in Slesse Creek has changed channel morphology from a meandering channel to a braided channel with increased bank erosion, oversimplifying instream habitat structure (Millar 2000). Steps to continue to improve instream channel structure and channel stability are necessary to recover suitable spawning and rearing habitat for bull trout.

1.2. Instream Impacts

1.3. Water Quality

2. Actions to Address Demographic Threats

None

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Monitoring angling impacts. Current regulations for Chilliwack Lake allow daily retention of one bull trout per angler, while catch and release is allowed in streams. Develop and implement appropriate level of monitoring to ensure fisheries continue to be sustainable and periodically

review harvest management and make recommendations for change as needed.

4.3 Nonnatives

Conservation Recommendations

- Ensure necessary and appropriate conservation actions are implemented to conserve the anadromous life history form suspected to be present in this core area, based on presence of individuals from the Chilliwack River population caught in lower Fraser River fisheries (Taylor and Costello 2006).
- Develop spawning index area(s) in local populations both within British Columbia and U.S. or other appropriate surrogate to provide capability of monitoring population trend of the core area.

Nooksack River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Legacy Forest Management and Agriculture Practices

1.1.1 Restore and protect riparian areas. Focus efforts on stream segments adjacent to agricultural lands to improve bank stability, stream shading, and reduce agricultural nutrient input as identified in WRIA [Watershed Resource Inventory Area] 1 Salmonid Recovery Plan (Whatcom County Public Works 2005). Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.1.2 Complete Road Maintenance and Abandonment Plans. Complete efforts identified under state forest practices' Road Maintenance and Abandonment Plans to limit impacts from forest road systems on private lands to reduce mass wasting rates in the Nooksack watershed.

1.2. Instream Impacts

1.3. Water Quality

Climate Change

1.3.1 Restore and protect groundwater and hyporheic sources in South Fork Nooksack River. Identify, restore, and protect groundwater and hyporheic sources and cold water refugia in the South Fork Nooksack River to ensure migration of the anadromous life history form and to maintain connectivity among core area local populations. Highest priorities for

protection are those sources located in local populations. Restoration efforts include installation of engineered log jams, while protection efforts include limiting water withdrawals from identified refugia areas. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Provide adequate fish passage around Bellingham Water Diversion. Upstream passage is currently impeded at this facility which limits connectivity between the two Middle Fork Nooksack River local populations, impedes expression of the anadromous life history form, as well as limits connectivity between other local populations within the Nooksack River core area. Restore passage as identified in WRIA 1 Salmonid Recovery Plan (Whatcom County Public Works 2005).

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Establish spawning index area(s). Currently there are no established spawning index areas in this core area to assess population trend or abundance. Develop spawning index area(s) in representative local populations to provide capability of monitoring population trend of the core area.

4.3 Nonnatives

4.3.1 Assess impact of brook trout. The presence of naturalized populations of brook trout pose significant risk of hybridization due to their broad distribution and overlap with key local populations in this core, even though these areas are currently dominated by migratory life history forms. Monitoring efforts should be developed to assess the level of risk.

Conservation Recommendations

- Implement all recovery actions identified in WRIA 1 Salmonid Recovery Plan (Whatcom County Public Works 2005) to further improve and/or maintain suitable habitat conditions for bull trout and their freshwater prey base in the core area.
- Develop and implement a proactive brook trout removal/suppression strategy in key local populations (local population within North Fork Nooksack) to reduce the potential risk of hybridization and competition.

Lower Skagit River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

1.2. Instream Impacts

Flood Control

1.2.1 Reduce stream channel degradation and increase channel complexity. Where feasible remove existing and prevent future bank armoring (bulkheads and riprap) and channel constrictions (*e.g.*, dikes and levees) associated with development and agriculture; restore connectivity to floodplain; and recreate lost off-channel habitat, and opportunities for off-channel habitat formation through time by protecting channel migration areas from encroachment during new construction or reconstruction of these structures as identified in the Skagit Chinook Recovery Plan (SRSC and WDFW 2005). Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.2.2 Practice non-intrusive flood control and flood repair activities. Provide technical assistance to Counties, Cities, and private landowners to develop options for fish friendly flood control methods and repair techniques. Ensure that negative effects to bull trout habitat from ongoing flood control activities (*e.g.*, dredging, woody debris removal, channel clearing, hardened bank stabilization, and riparian removal from dikes and levees) are avoided or minimized. Alternatives should emphasize restoration of floodplain connectivity and the elimination or setback of existing armored banks, dikes and levees to restore habitat forming processes.

1.3. Water Quality

Agricultural Practices and Residential Development and Urbanization

1.3.1 Restore and protect riparian areas. Seasonal high water temperatures in Skagit River tributaries are generally caused by removal of riparian trees

and reductions in stream flow (SRSC and WDFW 2005). Target tributary streams identified in the bull trout critical habitat designation (USFWS 2010), and focus protection and restoration efforts on stream segments adjacent to agricultural lands and developing areas to improve bank stability and stream shading as identified in the Skagit Chinook Recovery Plan (SRSC and WDFW 2005). Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.3.2 Maintain and/or restore adequate instream flows. Seasonal high water temperatures in Skagit River tributaries are generally caused by removal of riparian trees and reductions in stream flow (SRSC and WDFW 2005). Target tributary streams identified in the bull trout critical habitat designation (USFWS 2010), with efforts to protect or restore instream flows as identified in the Skagit Chinook Recovery Plan (SRSC and WDFW 2005). Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

Climate Change

1.3.3 Implement adequate emergency measures to address climate change impacts. Increasing variability in seasonal stream flows (extreme flood events and low flows) may require implementation of emergency actions such as fisheries closures, appropriate water-use restrictions, and/or assisted fish passage during certain years to prevent significant impacts to local populations. Ensure actions are timely and sufficient.

1.3.4 Develop and implement restoration projects to minimize climate change impacts. Restoration projects should prioritize minimization of water related impacts from climate change (*e.g.*, high stream temperatures, low base flows, seasonal high flows, delayed migration, impaired connectivity).

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Ensure adequate fish passage at Baker River hydropower project. Upstream and downstream fish passage at the Baker River Dams is reliant on continued implementation of settlement agreement articles under the FERC license (FERC 2008). Habitat connectivity for the anadromous life history form and population connectivity for the opportunity of genetic exchange will be reliant on ongoing fish passage efforts.

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.1.1 Verify potential high water temperatures in upper Sauk River. Anecdotal reports of high water temperatures in the upper Sauk River could have significant impacts to bull trout. This is a major natal basin of the Lower Skagit core area. Determine if seasonally high water temperatures exist, and if so, develop mitigation strategy.

4.2 Demographic

4.2.1 Continue ongoing population monitoring efforts within the basin. Maintain current long-term datasets assessing abundance and distribution of bull trout periodically. This will be critical to detect any significant changes in population distribution and abundance from potential climate change impacts.

4.3 Nonnatives

Conservation Recommendations

- Refine angling regulations as appropriate. Periodically review harvest management and make recommendations for change as needed.
- Develop and implement a proactive brook trout removal/suppression strategy in the Baker Lake local population to reduce the potential risk of hybridization and competition.
- Implement all recovery actions identified in Skagit Chinook Recovery Plan (SRSC and WDFW 2005) to further improve and/or maintain suitable habitat conditions for bull trout and their freshwater prey base in the core area.

Upper Skagit River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management

1.1.1 Provide adequate protection of spawning and rearing streams. Active timber harvest, road development and road maintenance in tributary basins outside of Skagit Valley and Manning Provincial Parks continue to impact instream habitat (Rawhouser *et al*. 2012; E. Connor, Seattle City Light, *in litt*. 2015). Implement riparian protections and road development practices that buffer or avoid impacts from ongoing forest development to protect bull trout spawning and rearing habitats.

1.2. Instream Impacts

Recreational Mining

1.2.1 Prevent or reduce impacts from recreational mining activities. Impacts related to small-scale placer mining activities have destabilized instream habitats within spawning and rearing tributaries (A. Rawhouser, North Cascades National Park, *in litt.* 2015). Recent increase in popularity of gold mining and the higher likelihood of this activity occurring in smaller tributaries will require appropriate regulation of recreational mining activities and outreach to miners to prevent increasing impacts to spawning and rearing habitats for bull trout.

1.3. Water Quality

Mining

1.3.1 Address contaminant exposure from Silver Daisy Mine. Heavy metal contamination was detected in Silver Daisy Creek near the confluence of the upper Skagit River and has been linked to the historic Silver Daisy Mine, British Columbia (Perrin and Bennett 2010). Actions should be implemented to stem spread of contaminant exposure to the upper Skagit River. Silver Daisy Creek discharges into a known spawning and holding reach (LGL Limited 2005; Anaka *et al*. 2010).

1.3.2 Prevent downstream contamination from Giant Copper Mine development. The proposed Giant Copper Mine (Robertson 2006) is located upstream of the majority of spawning and rearing habitat in the upper Skagit River. Because of the significant impact contaminant exposure could have on the upper Skagit River and Ross Lake, any development of the mine site will require measures to ensure containment of mining related contaminants.

1.3.3 Address legacy impacts from industrial mining in Ruby Creek. Tailings at the abandoned Azurite Gold Mine in the Ruby Creek drainage of the upper Skagit were found to possess toxic levels of copper, lead, and arsenic (Wolff *et al.* 2002). These mine tailings drain into bull trout spawning and rearing areas within Mill Creek, Slate Creek, and Canyon Creek. Areas immediately below mine tailings were found to have reduced invertebrate diversity and waste rock dump was noted as having potential for catastrophic erosion (Cascade Earth Sciences 2005).

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Ensure appropriate level of population connectivity. Recent genetic analysis places the isolated bull trout populations in Gorge and Diablo reservoirs in with the local populations of the Upper Skagit River core area (Smith and Naish 2010). Persistence of the associated local populations and bull trout distribution within these two reservoirs may require intervention measures to enhance population connectivity with other Upper Skagit River core area local populations.

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

3.1 Nonnative Fish

Hybridization

3.1.1 Develop and implement brook trout removal/suppression strategy. Implement strategy in key local populations (*e.g.*, Hozemeen, Silver, Lightning, Canyon and Nepopekum creeks) to reduce risk of hybridization and competition. Efforts should target large reproductive adults.

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Evaluate the role and necessity of the local populations within Gorge and Diablo Reservoirs. Determine how essential these local populations are to the long-term persistence of bull trout in the Upper Skagit River core area.

4.2.2 Continue ongoing population monitoring efforts within the basin. Maintain current long-term datasets assessing abundance and distribution of bull trout periodically. This will be critical to detect any significant changes in population distribution and abundance.

4.3 Nonnatives

4.3.1 Monitor level of hybridization with brook trout and adjust removal/suppression strategy accordingly. Continue periodic genetic sampling on char captured in Ross Lake to detect presence of hybrids.

Conservation Recommendations

- Periodic monitoring of redside shiner impact to ecosystem. The relatively recent introduction of redside shiner to Ross Lake has had an apparent positive effect on bull trout populations in the Upper Skagit core area (Eckmann 2014). However, long-term impacts to the ecosystem are uncertain, especially since they are now the dominant prey for bull trout.

Stillaguamish River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management

1.1.1 Reduce rate of anthropogenic landslides. Timber harvest and associated forest road system has resulted in significant landslide activity within the basin (SIRC 2005). Complete efforts identified under state forest practices' Road Maintenance and Abandonment Plans to limit impacts from forest road systems on private lands to reduce mass wasting rates, and adequately buffer slide prone areas in timber harvest plans.

1.2. Instream Impacts

Recreational Mining

1.2.1 Prevent or reduce impacts from recreational mining activities. Recent increase in popularity of gold mining and the higher likelihood of this activity occurring in smaller tributaries will require appropriate regulation of recreational mining activities and outreach to miners to prevent increasing impacts to spawning and rearing habitats for bull trout.

1.3. Water Quality

Forest Management

1.3.1 Implement restoration activities on forested lands to reduce water temperatures. Timber harvest and associated forest road system has removed riparian forests, reduced channel complexity, and increased sediment loads to channels which have led to increasing stream temperatures (SIRC 2005), particularly in the South Fork Stillaguamish River, North Fork Stillaguamish River, and Deer Creek watershed which are important habitat areas for bull trout. Implement restoration strategy/actions to reduced stream temperatures as identified in the Stillaguamish Watershed Chinook Recovery Plan (SIRC 2005) to restore habitats in key migratory corridors and local populations. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

Residential Development and Urbanization

1.3.2 Implement restoration and protection activities in development areas to reduce water temperatures. Conversion of forested lands and floodplains to residential developments have cleared or impacted riparian areas and forest cover and reduced instream habitat complexity (SIRC 2005). Implement restoration strategy/actions to reduced stream temperatures as identified in the Stillaguamish Watershed Chinook Recovery Plan (SIRC 2005) to protect or restore habitats in key migratory corridors and local populations. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Provide adequate passage at Cook Slough weir. Fish sampling related to repair activities at the weir indicated bull trout attempt to migrate through this area at levels higher than previously expected (USFWS 2012). Migration for bull trout and other salmonids is either significantly delayed or impeded by the weir with additional risk of injury and mortality to individuals (B. Nordlund, National Oceanic and Atmospheric Administration, *in litt*. 2011; F. Goetz, Army Corps of Engineers, *in litt*. 2012). Improvements at the weir should be designed to allow adequate upstream passage and to avoid or minimize injury to migrating bull trout.

2.1.2 Ensure continued upstream passage at Granite Falls fishway. The migratory bull trout in the South Fork Stillaguamish River local

population are reliant upon this fishway to reach their spawning and rearing habitats. Make improvements/repairs to the facility as necessary.

2.2. Fisheries Management

2.3. Small Population Size

Genetic and Demographic Stochasticity

2.3.1 Reestablish or enhance populations of bull trout in the Stillaguamish core area. Based on survey efforts conducted in 2002 and 2003, the Upper Deer Creek and Canyon Creek local populations may be extirpated (M. Downen, Washington Department of Fish and Wildlife, *in litt*. 2008). Additionally, consistent low redd counts in the South Fork Stillaguamish local population suggest this population is at high susceptibility to stochastic events. Consider reintroduction into Upper Deer Creek and Canyon Creek or enhancement measures for the South Fork Stillaguamish River local population.

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Assess the feasibility of reestablishing or enhancing populations of bull trout in the Stillaguamish River core area. Conduct feasibility assessment for the Upper Deer Creek and Canyon Creek local populations.

4.2.2 Continue ongoing population monitoring efforts within the basin. Maintain current long-term datasets assessing abundance and distribution of bull trout periodically. This will be critical to detect any significant changes in population distribution and abundance.

4.2.3 Evaluate alternative to Cook Slough Weir. Assess long-term need for the Cook Slough weir and consider its removal to eliminate fish passage issues.

4.2.4 Conduct comprehensive assessment of Upper Deer Creek and Canyon Creek local populations. Conduct adequate survey efforts (AFS bull trout presence protocol- Peterson *et. al.* 2002) to determine if these local populations are extirpated.

4.3 Nonnatives

Conservation Recommendations

- Implement all recovery actions identified in Stillaguamish Watershed Chinook Recovery Plan (SIRC 2005) to further improve and/or maintain suitable habitat conditions for bull trout and their freshwater prey base in the core area.

Snohomish and Skykomish Rivers Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

1.2. Instream Impacts

Flood Control

1.2.1 Reduce stream channel degradation and increase channel complexity. Where feasible remove existing and prevent future bank armoring (bulkheads and riprap) and channel constrictions (*e.g.*, dikes and levees) associated with development and agriculture; restore connectivity to floodplain; and recreate lost off-channel habitat, and opportunities for off-channel habitat formation through time by protecting channel migration areas from encroachment during new construction or reconstruction of these structures as identified in the Snohomish River Basin Salmon Conservation Plan (SBSRF 2005). Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.2.2 Practice non-intrusive flood control and flood repair activities. Provide technical assistance to Counties, Cities, and private landowners to develop options for fish friendly flood control methods and repair techniques. Ensure that negative effects to bull trout habitat from ongoing flood control activities (*e.g.*, dredging, woody debris removal, channel clearing, hardened bank stabilization, and riparian removal from dikes and levees) are avoided or minimized. Alternatives should emphasize restoration of floodplain connectivity and the elimination or setback of existing armored banks, dikes and levees to restore habitat forming processes.

Recreational Mining

1.2.3 Prevent or reduce impacts from recreational mining activities. Recent increase in popularity of gold mining and the higher likelihood of this activity occurring in smaller tributaries will require appropriate regulation of recreational mining activities and outreach to miners to prevent increasing impacts to spawning and rearing habitats for bull trout.

1.3. Water Quality

Residential Development and Urbanization

1.3.1 Implement restoration and protection activities in development areas to reduce water temperatures. Conversion of forested lands and floodplains to residential developments have cleared or impacted riparian areas and forest cover and reduced instream habitat complexity (SBSRF 2005). Implement restoration strategy/actions to reduced stream temperatures as identified in the Snohomish River Basin Salmon Conservation Plan (SBSRF 2005) to protect or restore habitats in mainstem river reaches, key to the persistence of the anadromous life history form. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Ensure continued upstream passage at Sunset Falls. The migratory population for bull trout in the South Fork Skykomish River local population are reliant upon the ongoing operation and maintenance of the trap and haul facility at Sunset Falls.

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Continue ongoing population monitoring efforts within the basin. Maintain current long-term datasets assessing abundance and distribution of bull trout periodically. This will be critical to detect any significant changes in population distribution and abundance.

4.3 Nonnatives

Conservation Recommendations

- Implement all recovery actions identified in Snohomish River Basin Salmon Conservation Plan (SBSRF 2005) to further improve and/or maintain suitable habitat conditions for bull trout and their freshwater prey base in the core area.
- Refine angling regulations as appropriate. Periodically review harvest management and make recommendations for change as needed.

Chester Morse Lake Core Area

1. Actions to Address Habitat Threats

None

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Ensure future operations support connectivity. Future demands for municipal water have the potential to affect spawning migrations for both bull trout and their key prey (pygmy whitefish) if operating regimes in Chester Morse Lake are significantly changed in the future, especially when exacerbated by anticipated climate change impacts (D. Paige, Seattle Public Utilities, *in litt*. 2015). Operating regimes should continue in a manner that supports necessary habitat connectivity for bull trout and pygmy whitefish to complete their lifecycles.

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Continue ongoing population monitoring efforts within the basin. Maintain current long-term datasets assessing abundance and distribution

of bull trout periodically. This will be critical if any significant change to operating regimes is implemented in the future.

4.3 Nonnatives

Conservation Recommendations

- Monitor spawning and rearing habitat distribution, condition, and use over time to determine any significant adverse changes as a result of anticipated climate change impacts.

Puyallup River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management

1.1.1 Implement restoration actions targeting unstable or problem roads. Legacy forest roads continue to impact instream habitat particularly within the Carbon, upper Puyallup, and Mowich River systems (B. Wright *in litt*. 2015c). Implement restoration actions that eliminate or reduce road related impacts (mass wasting, sediment delivery, impaired fish passage) to bull trout spawning and rearing habitats.

1.1.2 Complete Road Maintenance and Abandonment Plans. Complete efforts identified under state forest practices' Road Maintenance and Abandonment Plans to limit impacts from forest road systems on private lands to reduce road related impacts to spawning and rearing areas in the upper Puyallup watershed.

1.2. Instream Impacts

Flood Control

1.2.1 Reduce stream channel degradation and increase channel complexity. Where feasible remove existing and prevent future bank armoring (bulkheads and riprap) and channel constrictions (*e.g.*, dikes and levees) associated with development and agriculture; restore connectivity to floodplain; and recreate lost off-channel habitat, and opportunities for off-channel habitat formation through time by protecting channel migration areas from encroachment during new construction or reconstruction of these structures as identified in Salmon Habitat Protection and Restoration Strategy (Pierce County Lead Entity 2012). Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.2.2 Practice non-intrusive flood control and flood repair activities. Provide technical assistance to Counties, Cities, and private landowners to develop options for fish friendly flood control methods and repair techniques. Ensure that negative effects to bull trout habitat from ongoing flood control activities (*e.g.*, dredging, woody debris removal, channel clearing, hardened bank stabilization, and riparian removal from dikes and levees) are avoided or minimized. Alternatives should emphasize restoration of floodplain connectivity and the elimination or setback of existing armored banks, dikes and levees to restore habitat forming processes.

Climate Change-glacial outbursts and channel widening

1.2.3 Ensure access to potential spawning and rearing refugia. Glacial outbursts and associated channel widening has had significant impacts to known spawning and rearing areas (B. Wright *in litt*. 2015a,b). Provide maximum access to tributary streams by ensuring passage at culverts located near confluence of spawning tributaries to mainstem rivers.

1.2.4 Implement any additional mitigation strategies developed for glacial outburst impacts. Implement additional mitigation strategies if possible to further reduce impact of glacial outbursts and associated channel widening to spawning areas (also see Research, Monitoring, and Evaluation section).

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Provide adequate fish passage around Buckley Diversion and Mud Mountain Dam. Upstream passage for the migratory life history form in the two White River local populations is dependent upon operation of the trap and haul facility at Buckley Diversion. The current facility is outdated and of insufficient capacity to accommodate numbers of returning salmonids. Update facility as identified in the Salmon Habitat Protection and Restoration Strategy (Pierce County Lead Entity 2012). Successful downstream passage is reliant on passage through Mud Mountain Dam. Improve upstream and downstream passage as necessary to ensure continued opportunity of the expression of the anadromous life history form in this core area.

Entrainment

2.1.2 Provide adequate downstream passage around Electron Dam. Unimpeded downstream passage for bull trout in the Upper Puyallup and Mowich

Rivers local population is dependent upon avoiding entrainment at the unscreened diversion at Electron Dam. Both juvenile and adult bull trout have been entrained into the flume and fore bay system (J. Vernard, Puget Sound Energy, *in litt*. 2012). Provide safe downstream passage at this facility as identified in the Salmon Habitat Protection and Restoration Strategy (Pierce County Lead Entity 2012).

2.2. Fisheries Management

2.3. Small Population Size

Genetic and Demographic Stochasticity

2.3.1 Ensure protection of existing spawning areas in the Upper Puyallup and Mowich Rivers local population. The apparent low abundance in this local population (B. Wright, Mount Rainier National Park, pers. comm. 2009) places this major branch of the Puyallup core area at risk of extirpation from stochastic events. Identification and any additional protection of known spawning areas are critical.

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

3.1 Nonnative Fish

Hybridization

3.1.1 Develop and implement brook trout removal/suppression strategy. The broad distribution of brook trout coupled with the resident life history form of bull trout being dominant within the Carbon River local population (B. Wright, pers. comm. 2009, *in litt*. 2015c), continue to place this key local population at significant risk to hybridization. Implement strategy in key areas to reduce risk of hybridization and competition. Efforts should prioritize removal in known bull trout spawning areas.

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.1.1. Evaluate projected impacts from climate change induced glacial outbursts. Assess outburst flood impacts to tributary spawning sites and identify potential mitigation strategies.

4.1.2. Evaluate projected impacts from climate change induced channel widening. Assess channel widening impacts to tributary and mainstem spawning sites and identify potential mitigation strategies.

4.2 Demographic

4.2.1 Determine limiting factors affecting abundance in the Upper Puyallup and Mowich Rivers local population. Conduct assessment of physical or biological limitations in this core area that are directly affecting local population abundance.

4.2.2 Assess the feasibility of enhancing populations of bull trout in the Upper Puyallup and Mowich Rivers local population. Conduct feasibility assessment for the Upper Puyallup and Mowich Rivers local population.

4.3 Nonnatives

4.3.1 Monitor level of hybridization with brook trout and adjust removal/suppression strategy accordingly. Evaluate the degree of hybridization and competition in the Carbon River system where and when sympatry occurs.

Conservation Recommendations

- Implement all recovery actions identified in Salmon Habitat Protection and Restoration Strategy (Pierce County Lead Entity 2012) to further improve and/or maintain suitable habitat conditions for bull trout and their freshwater prey base in the core area.

Puget Sound Shared FMO

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Puget Sound Marine

Residential Development and Urbanization

1.1.1 Implement protection activities in nearshore marine and estuarine habitats. Past and current impacts from residential development and urbanization along shorelines have significantly degraded nearshore habitats essential to anadromous bull trout and their marine preybase. Efforts should prioritize the protection of intact shorelines, key habitats, and natural shoreline processes (eel grass beds, forage fish spawning and holding areas, feeder bluffs), particularly those in close proximity to core areas or shared freshwater foraging, migration, and overwintering habitats. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.1.2 Implement restoration activities in nearshore marine and estuarine habitats. Past and current impacts from residential development and urbanization along shorelines have significantly degraded nearshore

habitats essential to anadromous bull trout and their marine preybase. Efforts should target the restoration or enhancement of natural shoreline features, shoreline processes, or key habitats that are currently degraded, particularly those in close proximity to core areas or shared freshwater foraging, migration, and overwintering habitats. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.2. Instream Impacts

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Lake Washington

Temperature Barriers

2.1.1 Address seasonal high water temperatures in Ship Canal. The Lake Washington Ship Canal has been identified as the most thermally impaired water bodies for salmon in western Washington, with extreme summertime water temperatures inhibiting the upstream migration of adult Chinook and sockeye salmon (Mantua *et al*. 2010). The ship Canal serves as the sole migratory corridor for salmon and bull trout between Puget Sound and the Lake Washington Basin. Develop mitigation strategies to ensure continued use of Lake Washington FMO habitats by anadromous bull trout.

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

Lower Green River

Preybase

2.4.1 Restore freshwater preybase. Depressed populations of salmon and steelhead in the Green River watershed significantly limit the available preybase to anadromous bull trout utilizing the system for foraging, migration, and overwintering. Implement recovery actions identified in the Salmon Habitat Plan for WRIA 9 (WRIA 9 Steering Committee 2005).

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

Puget Sound Marine

4.1.1. Assess impacts of contaminants to anadromous bull trout. Increasing residential development and urbanization exacerbates the ongoing transfer of contaminants into nearshore habitats of Puget Sound. Additional evaluation of the impacts to anadromous bull trout and to their key preybase (salmon and marine forage fish) is required to develop and implement any necessary and appropriate mitigation strategies.

4.2 Demographic

Puget Sound Marine

4.2.1 Assess importance of small independent streams to anadromous bull trout. Small independent streams play an important overwintering role for anadromous bull trout in the Olympic Peninsula region (Brenkman *et al*. 2007), but their role for Puget Sound populations is less clear due to the environmental setting. Additional evaluation of the locations and level of use by anadromous bull trout is required to develop and implement any necessary and appropriate protection and restoration strategies.

4.3 Nonnatives

Olympic Peninsula Region

Dungeness River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

1.2. Instream Impacts

Flood Control

1.2.1 Reduce stream channel degradation and increase channel complexity. Where feasible remove existing and prevent future bank armoring (bulkheads and riprap) and channel constrictions (*e.g.*, dikes and levees) associated with development and agriculture; restore connectivity to floodplain; and recreate lost off-channel habitat, and opportunities for off-channel habitat formation through time by protecting channel migration areas from encroachment during new construction or reconstruction of these structures as identified in the Elwha-Dungeness Watershed Plan

(EDPU 2005) and Recommended Land Protection Strategies for the Dungeness Riparian Area (Hals and DRRW 2003). Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.2.2 Practice non-intrusive flood control and flood repair activities. Provide technical assistance to Counties, Cities, and private landowners to develop options for fish friendly flood control methods and repair techniques. Ensure that negative effects to bull trout habitat from ongoing flood control activities (*e.g.*, dredging, woody debris removal, channel clearing, hardened bank stabilization, and riparian removal from dikes and levees) are avoided or minimized. Alternatives should emphasize restoration of floodplain connectivity and the elimination or setback of existing armored banks, dikes and levees to restore habitat forming processes.

1.3. Water Quality

Altered Flows

1.3.1 Improve instream flows. Chronic low stream flows in summer and fall are considered a critical limiting factor to salmonids in the Dungeness River (WDOE 2012). Low base flow conditions can delay or impede migration of anadromous bull trout. Continue to address the level of agricultural and residential water use in the Dungeness River watershed by implementing water quantity recommendations outlined in the Elwha-Dungeness Watershed Plan (EDPU 2005).

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

2.2. Fisheries Management

2.3. Small Population Size

Genetic and Demographic Stochasticity

2.3.1 Ensure protection of existing spawning areas in the Dungeness River and Gray Wolf River local populations. The apparent low abundance in the two known local populations (L. Ogg, U.S. Forest Service, pers. comm. 2004) potentially places one or both at risk of extirpation from stochastic events. Identification and any additional protection of known spawning areas are critical.

2.4. Forage Fish Availability

Preybase

2.4.1 Restore freshwater preybase. Depressed populations of salmon and steelhead in the Dungeness River watershed (ESA-listed Puget Sound Chinook, Hood Canal summer chum, and Puget Sound steelhead) significantly limit the available preybase to bull trout in the core area. Implement actions to recover/restore these populations of listed salmonids.

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Establish spawning index area(s). Currently there are no established spawning index areas in this core area to assess population trend or abundance. Develop spawning index area(s) in representative local populations to provide capability of monitoring population trend of the core area.

4.3 Nonnatives

Conservation Recommendations

- Implement all recommended protection and restoration actions identified in various salmon and watershed recovery planning documents for the Dungeness watershed (Bountry *et al*. 2002; EDPU 2005; Hals and DRRW 2003) to recover/restore these populations.

Elwha River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

1.2. Instream Impacts

Fish Passage Issues

1.2.1 Implement actions to improve fish passage at former dam sites. Residual channel obstructions (*e.g.*, boulders, debris) are currently believed to impair full unobstructed upstream passage at former dam sites. These potential impediments are being monitored and assessed for mitigation strategies.

1.3. Water Quality

Instream Flows

1.3.1 Implement actions to ensure adequate instream flows. The magnitude of the current water right for the City of Port Angeles poses a risk to the fisheries resources in the Elwha River (Ward *et al*. 2008). Implement actions to ensure adequate instream flow for the recovery of bull trout and their freshwater preybase (*i.e.*, salmon and steelhead).

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

Preybase

2.4.1 Restore freshwater preybase. Depressed populations of salmon and steelhead associated with lack of upstream fish passage at Elwha River dams for nearly 100 years, significantly limit the available preybase to bull trout in the core area. Continue to implement the post-dam removal adaptive management recommendations identified for managing the restoration of Chinook salmon and steelhead on the Elwha River (Peters *et al*. 2014).

3. Actions to Address Nonnative Fishes

3.1 Nonnative Fish

Hybridization

3.1.1 Develop and implement brook trout removal/suppression strategy. With recent dam removal, bull trout that were primarily restricted to areas upstream of the Elwha River dams are now more readily utilizing habitats in downstream tributaries with established brook trout populations. Consistent with the Bull Trout Protection and Restoration Plan for the Elwha River Restoration Project (Crain and Brenkman 2010), implement strategy focusing on spawning and rearing tributaries (*e.g.*, Indian, Griff, and Hughes creeks, Little River) which are now increasingly used by bull trout since dam removals, to reduce risk of hybridization and competition and eliminate further brook trout invasion upstream.

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Monitor and evaluate fisheries impacts. Direct and incidental catch of bull trout has been extremely limited given regulations in place, limited available fisheries, and restricted habitat use in the Elwha River Basin prior to dam removal. However, future incidental take of bull trout in commercial gill-net and sport fisheries is expected after March 2017, when fisheries are scheduled to resume. Develop and implement appropriate level of monitoring to ensure fisheries do not significantly impact bull trout recovery, and periodically review harvest management and make recommendations for change as needed.

4.2.2 Establish spawning index area(s). Updated spawning or adult index areas may need to be establish in this core area to assess population trend or abundance. Develop index area(s) in representative spawning habitats or develop other appropriate surrogate to provide capability of monitoring population trend of the core area.

4.3 Nonnatives

4.3.1 Monitor level of hybridization with brook trout and adjust removal/suppression strategy accordingly. Conduct periodic genetic sampling on char captured in bull trout spawning areas overlapping brook trout distribution to detect presence of hybrids.

Hoh River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Transportation Networks

1.1.1 Reduce transportation corridor impacts on mainstem river. The upper Hoh Road provides the primary access to Olympic National Park, but constricts the river and is vulnerable to washouts. Repair and reconstruction efforts both within and outside of the park have armored significant portions of the river's banks and reduced channel complexity. Where possible, relocate vulnerable sections of the road that lie in riparian areas or the floodplain. Where sections cannot be moved, utilize more natural and complex stream bank protection measures to stabilize roads. In addition, ensure fish passage is maintained at crossing structures under the Hoh Road to allow juvenile bull trout use of rearing and refugia habitats.

1.2. Instream Impacts

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

2.2. Fisheries Management

Angling or Harvest

2.2.1 Ensure fisheries do not impede recovery. Direct and incidental catch of bull trout from commercial gill net and popular recreational angling fisheries on the coast (Brenkman *et al*. 2007; Kerr *et al*. 2013; E. Harvey, NPS, *in litt*. 2014) can have significant selective pressure on older and larger bull trout (Brenkman *et al*. 2007). Develop and implement strategies to reduce incidental mortality of larger spawners caught in fisheries.

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Monitor and evaluate fisheries impacts. Develop and implement appropriate level of monitoring to ensure fisheries do not significantly impact bull trout recovery, and periodically review harvest management and make recommendations for change as needed.

4.2.2 Establish spawning index area(s). Develop index area(s) in representative spawning habitats or implement other appropriate surrogate to provide capability of monitoring population trend of the core area.

4.3 Nonnatives

Conservation Recommendations

- Implement all recommended actions and management strategies identified in Water Resource Inventory Area 20 Watershed Management Plan (Golder Associates 2009).

Queets River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management

1.1.1 Implement restoration actions targeting unstable or problem roads. Legacy forest roads continue to impact instream habitat particularly within areas outside of Olympic National Park. Implement restoration actions that eliminate or reduce road related impacts (mass wasting, sediment delivery, impaired fish passage) in bull trout spawning and rearing habitats consistent with the WRIA 21 Salmon Habitat Recovery Strategy (QIN 2011).

1.2. Instream Impacts

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

2.2. Fisheries Management

Angling or Harvest

2.2.1 Ensure fisheries do not impede recovery. Direct and incidental catch of bull trout from commercial gill net and popular recreational angling fisheries (Brenkman *et al*. 2007; Kerr *et al*. 2013; E. Harvey *in litt*. 2014) can have significant selective pressure on older and larger bull trout (Brenkman *et al*. 2007). Develop and implement strategies to reduce incidental mortality of larger spawners caught in fisheries.

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Monitor and evaluate fisheries impacts. Develop and implement appropriate level of monitoring to ensure fisheries do not significantly

impact bull trout recovery, and periodically review harvest management and make recommendations for change as needed.

4.2.2 Establish spawning index area(s). Develop index area(s) in representative spawning habitats or implement other appropriate surrogate to provide capability of monitoring population trend of the core area.

4.3 Nonnatives

Conservation Recommendations

- Implement all recommended actions identified in the WRIA 21 Salmon Habitat Recovery Strategy (QIN 2011).

Quinault River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Transportation Networks

1.1.1 Reduce transportation corridor impacts on mainstem river. The North Shore, South Shore, road to Graves Creek Guard Station, and North Fork Road constrict the river and are vulnerable to washouts. Repair and reconstruction efforts both within and outside of the park have armored significant portions of the river's banks and reduced channel complexity (WSCC 2001). Where possible, relocate vulnerable sections of the road that lie in riparian areas or the floodplain. Where sections cannot be moved, utilize more natural and complex stream bank protection measures to stabilize roads. In addition, ensure fish passage is maintained at crossing structures under the roads to allow juvenile bull trout use of rearing and refugia habitats.

Loss of Channel Complexity

1.1.2 Restore habitat complexity in Middle Reach. The upper Quinault River has changed significantly with past and ongoing habitat loss and flood plain degradation (Bountry *et al*. 2005; Schlosser *et al*. 2011). This reach is important for both bull trout and a key part of their freshwater preybase (sockeye salmon). Implement appropriate restoration actions identified in Bountry *et al*. (2005) and the WRIA 21 Salmon Habitat Recovery Strategy (QIN 2011) to stabilize this channel and restore this river reach.

1.2. Instream Impacts

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

2.2. Fisheries Management

Angling or Harvest

2.2.1 Ensure fisheries do not impede recovery. Direct and incidental catch of bull trout from commercial gill net and popular recreational angling fisheries (Brenkman *et al*. 2007; Kerr *et al*. 2013; E. Harvey *in litt*. 2014) can have significant selective pressure on older and larger bull trout (Brenkman *et al*. 2007). Develop and implement strategies to reduce incidental mortality of larger spawners caught in fisheries.

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Monitor and evaluate fisheries impacts. Develop and implement appropriate level of monitoring to ensure fisheries do not significantly impact bull trout recovery, and periodically review harvest management and make recommendations for change as needed.

4.2.2 Establish spawning index area(s). Develop index area(s) in representative spawning habitats or implement other appropriate surrogate to provide capability of monitoring population trend of the core area.

4.3 Nonnatives

Conservation Recommendations

- Implement all recommended actions identified in WRIA 21 Salmon Habitat Recovery Strategy (QIN 2011).

Skokomish River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management

1.1.1 Implement restoration actions targeting unstable or problem roads. Legacy forest roads continue to impact instream habitat particularly within the South Fork Skokomish River system. Since the 1990s, significant efforts have been made to decommission and stabilize roads within the basin (USACOE 2014). Continue to implement restoration actions that eliminate or reduce road related impacts (mass wasting, sediment delivery, impaired fish passage) to bull trout spawning and rearing habitats.

1.2. Instream Impacts

Flood Control

1.2.1 Reduce stream channel degradation and increase channel complexity. Alteration of the river environment and encroachment on the floodplain by man-made structures have degraded and continue to affect natural ecosystem structures, functions, and processes necessary to support critical fish and wildlife habitat throughout the basin (USACOE 2014). Where feasible remove existing and prevent future bank armoring (bulkheads and riprap) and channel constrictions (*e.g.*, dikes and levees) associated with development and agriculture; restore connectivity to floodplain; and recreate lost off-channel habitat, and opportunities for off-channel habitat formation through time by protecting channel migration areas from encroachment during new construction or reconstruction of these structures as identified in the Draft Integrated Feasibility Report and Environmental Impact Statement for the Skokomish River Basin Ecosystem Restoration (USACOE 2014).

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Ensure adequate fish passage at Cushman hydropower project on the North Fork Skokomish River. Upstream and downstream fish passage at the Cushman Dams on the North Fork Skokomish River is reliant on continued implementation of settlement agreement articles under the FERC license (FERC 2010). Habitat connectivity for the anadromous life history form and population connectivity for the opportunity of genetic exchange will be reliant on ongoing fish passage efforts.

2.1.2 Implement actions to address channel aggradation on the mainstem and South Fork Skokomish Rivers. The major problem affecting salmon survival and migration is extensive aggradation in the South Fork and mainstem riverbeds (USACOE 2014). Aggradation causes areas of the South Fork Skokomish River to run subsurface during the summer low flow period, which blocks passage for endangered fish species during the migration season; aggradation in the Skokomish River has reduced channel capacity in the mainstem, which causes frequent overbank flows and stranding fish during even modest flow events. Habitat connectivity for the anadromous life history form and population connectivity for the opportunity of genetic exchange will be reliant on ongoing fish passage efforts. Implement restoration opportunities as identified in the Draft Integrated Feasibility Report and Environmental Impact Statement for the Skokomish River Basin Ecosystem Restoration (USACOE 2014).

2.2. Fisheries Management

Angling or Harvest

2.2.1 Ensure fisheries do not impede recovery. Direct and incidental catch of bull trout from subsistence and popular recreational angling fisheries can have significant selective pressure on older and larger bull trout (Brenkman *et al*. 2007; E. Harvey *in litt*. 2014). Develop and implement strategies to reduce incidental mortality of bull trout, especially mature individuals, caught in fisheries in the Skokomish River mainstem and South Fork.

2.3. Small Population Size

Genetic and Demographic Stochasticity

2.3.1 Ensure protection of existing spawning areas in the South Fork Skokomish River local population. The apparent low abundance in one of the two known local populations (Ogg and Strutsman 2002; WSCC 2003) continues to place this population at risk of extirpation from stochastic events. Identification and any additional protection of known spawning areas are critical.

2.4. Forage Fish Availability

Preybase

2.4.1 Restore freshwater preybase. Depressed populations of salmon and steelhead associated with lack of upstream fish passage at the Cushman dams for nearly 100 years and extensive stream degradation on the South Fork Skokomish River significantly limit the available preybase to bull trout in the core area. Continue to develop and implement actions to recover anadromous salmon in the Skokomish core area under the FERC

relicensing settlement agreement (FERC 2010) and the Draft Integrated Feasibility Report and Environmental Impact Statement for the Skokomish River Basin Ecosystem Restoration (USACOE 2014).

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Assess the feasibility of reestablishing or enhancing populations of bull trout in the Skokomish River core area. Conduct feasibility assessment for the Browns Creek potential local population.

4.2.2 Continue ongoing population monitoring efforts within the basin. Maintain current long-term datasets assessing abundance and distribution of bull trout periodically. This will be critical to detect any significant changes in population distribution and abundance.

4.2.3 Evaluate recreational fisheries impact in relation to recent shift in migratory timing. Earlier river entry of adfluvial bull trout into the upper North Fork Skokomish River has led to an increase in abundance during a time of year when the recreational fishery is open for other species (S. Brenkman, NPS, *in litt*. 2014).

4.3 Nonnatives

Conservation Recommendations

- Implement all recommended actions under habitat recovery strategies identified in Recovery Plan for Skokomish River Chinook Salmon (SIT and WDFW 2010).

Olympic Peninsula Shared FMO

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Strait of Juan de Fuca Marine

Residential Development and Urbanization

1.1.1 Implement protection activities in nearshore marine and estuarine habitats. Past and current impacts from residential development and urbanization

along shorelines have significantly degraded nearshore habitats essential to anadromous bull trout and their marine preybase. Efforts should prioritize the protection of intact shorelines, key habitats, and natural shoreline processes (eel grass beds, forage fish spawning and holding areas, feeder bluffs), particularly those in close proximity to the Dungeness River and Elwha River core areas or shared freshwater foraging, migration, and overwintering habitats. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

1.1.2 Implement restoration activities in nearshore marine and estuarine habitats. Past and current impacts from residential development and urbanization along shorelines have significantly degraded nearshore habitats essential to anadromous bull trout and their marine preybase. Efforts should target the restoration or enhancement of natural shoreline features, shoreline processes, or key habitats that are currently degraded, particularly those in close proximity to Dungeness River core area or shared freshwater foraging, migration, and overwintering habitats. Use project prioritization identified in Puget Sound Partnership's most current near term action agenda.

Pacific Coast Marine

Forest Management Practices

1.1.1 Implement restoration actions in small independent tributaries. Although these small independent streams have been identified as either medium or low priority watersheds for salmon compared to larger natal watersheds (QIN 2011), these are key shared FMO habitats for anadromous bull trout (Brenkman *et al*. 2007; USFWS 2010). Many of these small streams whose estuaries and lower reaches are used by anadromous bull trout have been heavily impacted by past forest practices (QIN 2011). Implement appropriate protection and restoration actions identified in the WRIA 21 Salmon Habitat Recovery Strategy (QIN 2011).

1.2. Instream Impacts

1.3. Water Quality

2. Actions to Address Demographic Threats

None

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

Pacific Coast Marine

4.2.1 Establish overwintering index area(s). Develop index area(s) in representative shared FMO streams or develop other appropriate surrogate to provide capability of monitoring continued use of these streams by anadromous bull trout.

4.2.2 Monitor and evaluate fisheries impacts. Develop and implement appropriate level of monitoring to ensure fisheries do not significantly impact bull trout recovery, and periodically review harvest management and make recommendations for change as needed.

4.3 Nonnatives

Conservation Recommendations

Pacific Coast Marine

- Implement all recommended management strategies and actions identified in the Washington Coast Sustainable Salmon Plan (WCSSP 2013).

Chehalis River/Grays Harbor

- Assess potential for "re-establishing" a natal population of bull trout to the Satsop River watershed in the Chehalis Basin.

Lower Columbia River Region

Lewis River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Natural Event

1.1.1 Accelerate natural recovery of key areas that benefit spawning or rearing habitat. The 1980 eruption of Mt. St. Helens resulted in adverse impacts on the natural environment through debris and mud flows that resulted in impaired riparian conditions, increased width to depth ratios, reduced channel stability and complexity. Habitat impairments from 1980 eruption currently limit bull trout spawning and rearing habitat and will continue to do so into the future. The volcano remains active and therefore continues to be a source of potential stochastic events or consequences (*e.g.*, increased turbidity, catastrophic loss). Improve habitat in wide geographic

range. Restoration projects should focus on improving stream structure and stability.

Forest Management Practices

1.1.2 Implement restoration and maintenance actions targeting unstable hillslopes or problem roads on private lands. Past timber harvest practices degraded hillslope runoff and sediment delivery processes, which ultimately reduced channel stability and structure; thereby reducing bull trout population productivity. While regulations are in place to reduce impact of future timber harvests, adverse impacts from past timber harvests continue to impact bull trout productivity. Current road system adversely impacts hillslope runoff and sediment delivery processes, which ultimately reduces channel stability and structure; thereby reducing bull trout population productivity. Without proper maintenance, potential road failures could significantly reduce hillslope stability. Use of motorized vehicles to access Federal and private lands degrades upland and stream corridor conditions and associated watershed processes, especially when vehicle operation occurs off existing road system (*e.g.*, ATVs).

1.1.3 Addresses road maintenance needs on USFS lands. Current road system adversely impacts hillslope runoff and sediment delivery processes, which ultimately reduces channel stability and structure; thereby reducing bull trout population productivity. Without proper maintenance, potential road failures could significantly reduce hillslope stability.

1.1.4 Increase efforts to preserve and protect key bull trout habitat from development and/or overuse. Development pressure continues in parts of the Lewis River basin. Work with partners to protect key bull trout habitats, particularly, the confluences of Pine Creek and the Muddy River that are could be impacted from proposed development, and upland areas that protect watershed and hillslope processes.

1.1.5 Identify blockages in the basin, including recreational dams, and evaluate the impacts to bull trout rearing and spawning. Access within parts of the basin is limited due to small blockages (*e.g.*, inadequately sized culverts at road crossings) in the basin. Ephemeral dams are constructed by recreational users and residents to create recreational pools that also limit movement within the basin. Blockages limit access to potential spawning and rearing habitat; however, extent of blockages is unknown at this time. Address blockages when possible on Federal lands and on private land through the Family Forest Fish Passage Program.

1.1.6 Use natural processes to improve instream structure and riparian habitat. (*e.g.*, relocate problem beavers to build dams, create wetlands, and improve riparian habitat)

1.2. Instream Impacts

Entrainment

1.2.1 Establish barrier nets at intakes on all three hydroelectric facilities. Bull trout are entrained at the three PacifiCorp dams (Merwin, Yale, and Swift Dams) on the mainstem Lewis River, which results in immediate mortalities and reduces overall population abundance and productivity. Establish barrier nets within next 10 years as prescribed by the Lewis River Settlement Agreement (PacifiCorp *et al*. 2004).

1.3. Water Quality

Residential and Recreational Development

1.3.1 Monitor water withdrawals and diversions. Private development impacts instream flows and overall water quality through ground water usage (*e.g.*, wells), septic systems, water diversions and water withdrawals. In issuing new water rights, consideration should be given to maintaining sufficient instream flows for aquatic resources, including bull trout. Work to implement watershed planning measures, including water-use regulations and reduction of unauthorized water withdrawals in accordance with WRIA 27/28 Watershed Management Plan and Department of Ecology administrative rule.

1.3.2 Work with county to manage forest conversion. Conversion of forest land to residential development or recreational uses will increase wildfire risk and increase adverse impacts to stream channel structure, riparian function and floodplain function. Additionally, infrastructure to support residential and recreation use will reduce hillslope stability and increase sediment inputs into streams. Efforts should prioritize protection of natural hillslope and watershed processes.

1.3.3 Address impacts from residential and recreational development. Past development of private lands for residential or recreational needs has resulted in degradation of stream channel structure, riparian function and floodplain function, which adversely impacts bull trout productivity. Adverse impacts from past development will continue to the future. While the threat of development on private lands has been reduced through recent land purchases by Columbia Land Trust, potential for additional development still exists within the basin.

Climate Change

1.3.4 Increase protection of currently accessible cold water sources. Also restore and/or provide access to additional cold water sources, and identify additional potential sources of coldwater. Changes predicted to occur in the next few decades are expected to reduce the stability of the basin by reducing annual snowfalls and snowpack and increasing rain events. Future predicted changes in climate are expected to increase the potential

for more dynamic flow regime, more frequent high winter flows, lower summer water levels, increased isolation of cold water habitats and reduced habitat quality in migration corridors and foraging areas. Climate change is expected to reduce instream flows during critical time periods and expected to result in the loss of some cold water habitat currently supporting bull trout in the Lewis basin.

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Provide adequate upstream and downstream passage. The three dams on the mainstem Lewis River reduce connectivity in the North Fork Lewis basin by preventing upstream passage of adult bull trout and downstream passage of juvenile, bull trout. Lack of connectivity reduces the potential for genetic interchange between the bull trout populations in the North Fork Lewis basin. Lack of passage between the upper and lower portions of the basin inhibits the opportunity of the expression of an anadromous life history strategy. Within the next 15 years, provide upstream and downstream passage as described in the Lewis River Settlement Agreement (PacifiCorp *et al*. 2004).

Limited Extent of Habitat

2.1.2 Improve quantity and quality of habitat. The lack of quality spawning habitat is limiting abundance and productivity of the Lewis population. The majority of spawning occurs in limited areas within one to two streams. The Lewis basin lacks a network of quality spawning habitat that is geographically well distributed. Establish a network of quality habitat throughout basin, including access to currently blocked habitat. Use current funding sources (*i.e.*, Aquatics Coordination Committee funding) and identify additional funding sources to identify, prioritize and implement restoration actions.

2.2. Fisheries Management

Angling or Harvest

2.2.1 Increase enforcement of fishery regulations. Incidental handling of bull trout in a catchable trout fishery in Swift Reservoir results in an unknown level of mortality to adult and juvenile bull trout. There is some level of illegal retention of bull trout occurring in fisheries targeting catchable trout. Future fisheries for anadromous salmonids, assuming reintroduction efforts will be successful, is expected to increase incidental catch and potential for illegal harvest of bull trout in fisheries targeting anadromous

salmonids. Adequate enforcement may require additional WDFW officers, and help from other wildlife law enforcement entities.

2.2.2 Increase efforts to inform anglers. In order to reduce incidental mortality of bull trout, increase angler awareness of fishing regulations, including purpose and need for regulations, and accurate fish identification.

2.3. Small Population Size

Genetic and Demographic Stochasticity

2.3.1 Increase population size if less than demographic threshold. The suite of actions could include: translocation from populations inside or outside of the basin, a limited hatchery supplementation program, and translocation into unoccupied habitats within or outside the basin.

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.1.1 Conduct a climate change vulnerability assessment. Identify predicted effects to habitat, and resulting impacts on bull trout and their prey species, based on climate change scenarios.

4.1.2 Evaluate impacts of reservoir drawdowns. It is assumed that reservoir drawdowns can negatively impact bull trout in several ways: 1) may increase juvenile bull trout susceptibility to predation due to reduced space in reservoir, 2) may increase competition for prey 3) reduces emergent vegetation that supports prey production, and 4) reduces foraging effectiveness due to increased turbidity. These assumptions have not been tested using a scientific study; therefore, data do not exist to confirm or dispute these assumptions. In the interim, coordinate with PacifiCorp to minimize drawdowns to the fullest extent possible within hydropower operational framework, and manage for as few spill events as possible. Avoid entrainment as much as possible when spilling (*e.g.*, exclusion nets).

4.2 Demographic

4.2.1 Monitor interactions between bull trout and reintroduced salmonids. Reintroduction of anadromous salmonids into the upper Lewis basin will result in interactions between bull trout and reintroduced salmonids that may have positive or negative outcomes. At this time, reintroduction

success and results of the aforementioned interactions are unknown. Adaptively manage the reintroduction strategy to benefit all species.

4.2.2 Assess potential translocation of bull trout into coldwater sources not currently accessible. To address potential loss of cold water habitat in the Lewis River Basin, evaluate potential to establish in-basin or out-of-basin (*e.g.*, White Salmon, Kalama, and North Santiam) refugia populations.

4.2.3 Monitor and evaluate fisheries impacts. Develop and implement appropriate level of monitoring to ensure current and future fisheries do not significantly impact bull trout recovery, and periodically review harvest management and make recommendations for change as needed.

4.2.4 Determine the demographic threshold (*i.e.*, minimum population size). This is needed to ensure population viability and to avoid negative genetic impacts associated with small population size. During 1994 through 2014 the estimated number of migrating adults has ranged from 100 to 1,300. Since 2007 the estimated number of migrating adults has ranged from 300 to 600 fish, which is near the low end of the abundance estimates observed over the last 2 decades. Preliminary genetic analyses indicate that a small number of adults may be producing the majority of offspring in the Lewis basin. Adult spawning activity occurs in a very limited portion of the Lewis basin.

4.2.5 Evaluate population size as compared to the demographic threshold identified in action 4.2.4. Identify appropriate metrics for evaluating population size.

4.2.6 Evaluate population abundance monitoring. Currently, the Swift Reservoir population abundance is monitored using a mark-resight (snorkel) approach, and the Yale Reservoir population is monitored by conducting a census redd count in the only known spawning tributary to Yale Reservoir. Population abundance monitoring should continue; however, the current approaches should be evaluated to determine whether they generate precise and unbiased population estimates. Adjustments to the current approaches should be made if necessary, and/or alternative approaches (*e.g.*, census redd counts, juvenile abundance) should be explored to determine the most appropriate approach(es) to use in the basin. Population trend monitoring (*i.e.*, index reach redd counts in P8, tributary to Pine Creek) should continue to maintain and build upon the time series. Monitoring with a statistically robust approach will help determine whether the threat of a small population size is being adequately managed.

4.2.7 Continue genetic monitoring. This information will help determine whether the threat of small population size is being managed effectively. Continue to collect genetic samples throughout the basin to monitor genetic diversity and effective population size.

4.2.8 Expand spatial and temporal distribution monitoring. The extent of the spatial distribution of bull trout in the Lewis River basin is poorly understood. Current monitoring is limited to PIT (passive integrated transponder) arrays deployed in known occupied habitat, and at the mouth of large tributaries, and is limited to monitoring the adult life stage of the adfluvial population. Programs should be implemented to determine the entire spatial distribution of bull trout in the basin, including juvenile rearing, occurrence of resident populations above natural passage barriers, and juvenile and adult distribution in the reservoirs. Movement timing studies should be expanded to capture juvenile movement and temporal patterns of entrainment at the dams for both juvenile and adult life stages. More intense spatial and temporal distribution monitoring will provide information to help determine whether connectivity and reservoir management threats are being adequately managed, and provide baseline information regarding spatial and temporal distribution response to climate change.

4.3 Nonnatives

Conservation Recommendations

- Develop and implement a proactive brook trout removal/suppression strategy. There is an established resident brook trout population in the upper Lewis basin, however, the size of the population and their interaction with bull trout is unknown at this time. Based on past genetic analyses, it is thought that hybridization is low.

Klickitat River Core Area

1. Actions to Address Habitat Threats

None

2. Actions to Address Demographic Threats

None

3. Actions to Address Nonnative Fishes

3.1 Nonnative Fish

Hybridization and Competition

3.1.1 Develop and implement brook trout removal/suppression strategy. The broad distribution of brook trout coupled with the resident life history form of bull trout being dominant within the West Fork Klickitat River local population (Thiesfeld *et al*. 2001), continue to place this key local population at significant risk to hybridization. Implement strategy in key

areas to reduce risk of hybridization and competition. Efforts should prioritize removal in known bull trout spawning areas.

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Establish spawning index area(s). Develop index area(s) in representative spawning habitats of the West Fork or implement other appropriate surrogate to provide capability of monitoring population trend of the core area.

4.3 Nonnatives

4.3.1 Assess risk of hybridization with brook trout and adjust removal/suppression strategy accordingly. Evaluate the degree of hybridization and competition where and when sympatry occurs.

Conservation Recommendations

- Ensure key bull trout habitats in the West Fork Klickitat River are protected from development or overuse.

Hood River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management and Agricultural Practices

1.1.1 Restore instream channel conditions. Conduct stream channel restoration activities where warranted and cost-effective. Current and legacy forest management and agricultural practices, particularly splash damming, salvage logging, road building and orchard development, have channelized and oversimplified instream habitat structure. Large mainstem channels lack floodplain interaction, secondary channels, off channel habitat and the channel structure necessary to retain large wood to create complex habitat for bull trout. Steps to improve instream channel structure are necessary to create suitable rearing and spawning habitat for bull trout. Implement channel restoration and wood addition actions outlined in the Hood River Watershed Action Plan (HRWG 2014) and in Middle Fork Irrigation District's (MFID) 2010 Fisheries Management Plan (FMP).

1.2. Instream Impacts

Water Management

1.2.1 Improve instream flows. Low flows caused by water withdrawal at Clear Branch Dam and Coe and Eliot diversions reduce available spawning and rearing habitat downstream and impede migration during the summer and fall. Altered flow regimes (rapid ramping rates) may also strand bull trout in Clear, Coe, and Eliot Branches. Implement actions described in Middle Fork Irrigation District's (MFID) 2010 Fisheries Management Plan (FMP) to conduct an instream flow study aimed at identifying a flow regime that alleviates impacts to bull trout habitat while addressing MFID needs. Follow through on the implementation of the recommendations produced in the study.

1.2.2 Improve sediment routing. Clear Branch Dam and Coe and Eliot diversions block bedload transport and alter sediment routing below the dam. The resulting low gravel supply decreases the quantity and quality of bull trout spawning and rearing habitat. Implement actions described in the FMP (MFID 2010) to supplement coarse substrates with material suitable to mimic bedload characteristics shaped by fluvial processes and include sizes used by salmonid fishes.

1.2.3 Improve wood routing. Large wood capable of providing cover and complex habitat for bull trout is unable to pass Clear Branch Dam. Wood accumulations above the dam are removed according to FERC requirement. Implement actions described in the FMP (MFID 2010) to address the need to provide large wood transport around the dam.

1.3. Water Quality

Water Management

1.3.1 Improve water temperature below Laurance Lake during the spawning period (late summer to early fall). Reservoir operations and altered flows result in an increase in stream temperature below Clear Branch Dam. Implement actions described in the FMP (MFID 2010) to identify opportunities for cold water augmentation resulting in a reduction of stream temperatures downstream of Clear Branch Dam.

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Fish Passage Issues

2.1.1 Restore upstream and downstream fish passage at Clear Branch Dam. Currently Clear Branch Dam prevents upstream passage of migrating bull trout. Downstream passage is limited to instances when the reservoir spills during winter or spring. Implement actions described in the FMP

(MFID 2010) and the associated feasibility study to re-establish connectivity.

Water Management

2.1.2 Secure instream flows and/or water rights where opportunities exist to restore connectivity for migration. Increased flows will also improve water quality conditions.

2.1.3 Improve agricultural irrigation efficiency. Increase instream flows by improving irrigation efficiency including upgrading irrigation system components, piping open ditches and canals, moderating irrigation pressure and transferring conservation savings to an instream water right. Implement actions identified in the Hood River Watershed Action Plan (HRWG 2014) to identify efficiencies and improve instream flows.

2.2. Fisheries Management

2.3. Small Population Size

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.1.1 Continue to monitor for pesticides, herbicides and other toxic substances in stream reaches occupied by bull trout. This can be done in conjunction with the Hood River Pesticide Stewardship Partnership (HRWG 2014) and pesticide monitoring measures as described in the Hood River Watershed Action Plan. Investigate the effects of chronic and acute exposure to these chemicals on the biology and ecology of bull trout.

4.2 Demographic

4.2.1 Continue maintenance and operation of fish screens on all diversions. Given the volatile and flashy nature of the hydrograph in this system constant monitoring and maintenance is necessary to keep fish screens operating properly.

4.2.2 Continue ongoing population monitoring efforts within the basin. Maintain current long term datasets assessing abundance and distribution of bull trout, including, but not limited to, redd count and PIT tag methodologies. Continue to coordinate surveys among partner agencies.

4.2.3 Monitor for disease and pathogens once passage at Clear Branch Dam is re-established.

4.3 Nonnatives

Conservation Recommendations

- Refine angling regulations. Develop and implement sport angling regulations that minimize incidental mortality of bull trout in fisheries closed to bull trout harvest. Periodically review harvest management and make recommendations for change as needed.
- Research extent of use of the Columbia River FMO. Determine use in the Columbia River by Hood River bull trout, including distribution, timing and extent of movement patterns, preferred habitat and prey base. Include examination of potential interaction with bull trout in Klickitat River core area.
- Monitor and assess upstream movement of bull trout past two newly created falls on Middle Fork Hood River. In 2006 a debris torrent created two falls on Middle Fork Hood River. The structure and form of the falls continue to change with each significant hydrologic event. Currently upstream passage of bull trout may be sporadic at best depending on structure and the volume of instream flow.

Lower Deschutes River Core Area

1. Actions to Address Habitat Threats

None

2. Actions to Address Demographic Threats

None

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Continue ongoing population monitoring efforts within the basin. Maintain current long term datasets assessing abundance and distribution of bull trout including, but not limited to, redd counts and PIT tag methodologies. Continue to coordinate surveys among partner agencies.

4.2.2 Continue to monitor angling impacts in the spring fishery of Lake Billy Chinook to ensure harvest of spawner population is limited and does not reduce population viability.

4.2.3 Continue to monitor spawner and juvenile densities in the Warm Springs River, assess possible factors contributing to a depressed population.

4.3 Nonnatives

4.3.1 Continue to assess and monitor distribution of brook trout and bull trout. Evaluate the degree of hybridization and competition where and when sympatry occurs.

Conservation Recommendations

- Continue implementation of the long-term passage plan at the Pelton-Round Butte hydro project to provide upstream and downstream passage of bull trout. Follow measures and schedules outlined in the FERC license issued in 2005.
- Continue ongoing maintenance and operation of fish screens at water diversions and irrigation ditches.
- Continue to implement all land management plans and Best Management Practices to ensure continued protection and enhancement of bull trout habitat and water quality.
- Where necessary and feasible, adaptively manage bull trout and kokanee harvest in Lake Billy Chinook. Provide management agencies the flexibility to manage harvest and angling to best meet the needs of the lower Deschutes bull trout populations.
- Implement management, actions where necessary and feasible, to reduce distribution and abundance of brook trout in Warm Springs River, Shitike Creek, and Canyon Creek.

Upper Willamette River Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

Forest Management Practices

1.1.1 Develop and implement stream, riparian, and upland restoration projects that improve habitat for bull trout and spring Chinook salmon as an essential prey base. Legacy forest management practices, recreational development, and existing infrastructure have resulted in overly simplified habitat in streams utilized by bull trout and spring Chinook salmon. Significant losses of pool habitat, instream structure, cover, and floodplain connectivity and increases in temperature due to historical wood removal

and riparian harvest all have been cited as limiting ecological function and biological productivity (Chamberlain *et al*. 1991; USFWS 2004; ODFW 1993; Unthank and Sheehan 1994). Restoration activities should focus on: increasing instream habitat complexity, off-channel habitat, and high flow refugia by adding large wood; managing riparian areas for a future supply of large wood, adequate shade, and diverse allochthonous inputs; and reducing fine sediment and water quality impacts from roads and recreational development.

1.2. Instream Impacts

Altered flows and geomorphic processes

1.2.1 Identify environmental flow and wood, sediment, and nutrient supply improvement opportunities in the McKenzie and Middle Fork Willamette Rivers. Alteration of the hydrologic, wood, sediment, and nutrient regimes caused by construction and operation of the dams have resulted in overly simplified habitat in the mainstem McKenzie River, South Fork McKenzie River below Cougar, the Upper Middle Fork Willamette River, and tributaries utilized by bull trout and spring Chinook salmon. Significant losses of pool habitat, instream structure, cover, and floodplain connectivity have been cited as limiting ecological function and biological productivity (Chamberlain *et al*. 1991; USFWS 2004; ODFW 1993; Unthank and Sheehan 1994). Environmental flows include the full range of pulses or high flows that accomplish fish habitat maintenance and creation through mechanisms such as sediment distribution, channel forming processes, overbank flows and maintaining access to side channels. Wood, sediment, and nutrient supply should be augmented below dams to restore habitat forming processes. For opportunities below Army Corps of Engineers dams follow measures outlined in NMFS Biological Opinion on the Willamette River Basin Flood Control Project (USFWS 2008). Implement measures included in the FERC settlement agreement detailing recommended flows between Carmen and Trail Bridge reservoirs.

1.2.2 Provide more normative water temperatures in Middle Fork Willamette River below Hills Creek where high temperatures affect bull trout during late summer and fall. Implement interim temperature control measures detailed in the Reasonable and Prudent Alternatives of the NMFS Biological Opinion to evaluate and carry out, where feasible, provisional operations actions and use of existing conduits (*i.e.*, spill ways, regulating outlets etc.) to achieve some measure of temperature control.

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

Entrainment

2.1.1 Continue to document and evaluate entrainment of bull trout at Cougar, Trail Bridge, and Hills Creek dams as changes occur in reservoir operations.

2.1.2 Provide appropriate screening to prevent unsafe entrainment of bull trout through dams in the McKenzie and Middle Fork Willamette Rivers Sub-basins.

Fish Passage Issues

2.1.3 Re-establish connectivity by providing safe upstream and downstream passage at Trail Bridge, Hills Creek, Lookout Point and Dexter dams and downstream passage at Cougar Dam. Options for downstream and upstream passage at Trail Bridge Dam are components of EWEB's FERC relicense application awaiting FERC approval. In concordance with the NMFS and USFWS 2008 Biological Opinion, implement the Terms and Conditions associated with providing downstream fish passage through the USACE dams including assessing survival and efficiency through all available routes (*i.e.*,turbines, spillways, and regulating outlets) and proposing alternatives for reducing mortality to bull trout.

2.1.6 Continue to capture and move as appropriate bull trout holding below Hills Creek and Trail Bridge dams until upstream fish passage facilities are constructed and proven effective. Implement measure 1.2.1 from the Upper Willamette Basin Bull Trout Action Plan, which details recommendations for successful salvage of bull trout.

2.2. Fisheries Management

Illegal Harvest

2.2.1 Maintain a law enforcement presence in areas occupied by bull trout in order to ensure compliance with angling regulations, and concentrate patrols in known problem areas, including the McKenzie River, South Fork McKenzie, Trail Bridge Reservoir, Cougar Reservoir, Leaburg Lake, Hills Creek Reservoir, and the Middle Fork Willamette River above the reservoir.

2.2.2 Continue public education and awareness through road signs, posters, pamphlets, presentations and information available on the internet.

2.3. Small Population Size

2.4. Forage Fish Availability

Preybase

2.4.1 Continue to provide historical prey base by outplanting excess live hatchery spring Chinook salmon into above dam habitats occupied by bull trout. Juvenile spring Chinook Salmon are an important prey source for bull trout. The construction and operation of dams on the McKenzie River and Upper Willamette River eliminated spring Chinook above the dams for many years. The absence of spring Chinook limited the production of bull trout populations above the dams. Release adult salmon, out-plant viable eggs, or release hatchery fry above Trail Bridge, Cougar and Hills Creek dams until volitional fish passage is provided for spring Chinook.

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.1.1 Monitor and evaluate the effectiveness of habitat restoration and enhancement projects. Modify design and techniques as needed to ensure success.

4.2 Demographic

4.2.1 Continue ongoing comprehensive population monitoring efforts in all populations of the core area. Maintain current long term datasets assessing abundance, distribution and movement of bull trout, including, but not limited to, redd counts, snorkel survey, and PIT tag methodologies. Continue to coordinate surveys among partner agencies.

4.2.2 Continue to monitor and evaluate the status of the Middle Fork Willamette River bull trout population. Implement necessary actions to ensure its persistence and the success of the rehabilitation program.

4.3 Nonnatives

Conservation Recommendations

- Regularly update watershed analyses for subbasins currently occupied by bull trout. This task is necessary to determine appropriate U.S. Forest Service management activities and to help establish short- and long-term goals and actions compatible with bull trout recovery.

- Continue to monitor and identify existing road systems that have a high risk of adversely affecting bull trout habitat. Negative impacts include excessive sediment delivery, alteration and interruption of natural drainage networks (surface runoff), increase in drainage networks due to new road construction, and interruption of delivery of woody material.

- Complete access and travel management plans for all watersheds with Federal ownership in the Upper Willamette core area (McKenzie River and upper Middle Fork Willamette River) and identify existing road systems that have a high risk of adversely affecting bull trout. Negative changes include excessive sediment delivery, alteration and interruption of natural drainage networks (surface runoff), increase in drainage networks due to new road construction, and interruption of delivery of woody material.

- Continue to operate Cougar Dam upstream fish passage facility (trap and haul) minimally from April through October. Conduct operation following guidelines provided in measure 1.1.2 from the Upper Willamette Basin Bull Trout Action Plan (UWBTWG 2014).

- Continue maintenance and operation of fish screens on Leaburg-Walterville Hydroelectric facility and Cougar Dam Penstock.

- Monitor distribution of brook trout and assess threats to bull trout from hybridization and competition with brook trout. If necessary, appropriate and feasible, implement measures to reduce threats of brook trout. Brook trout are present in Trail Bridge and upper McKenzie populations. In Middle Fork Willamette brook trout are abundant upstream of current bull trout distribution. Hybridization rates in Trail Bridge, the only population with documented evidence of hybridization, were estimated to be 5 percent (EWEB 2006).

- Continue to investigate and implement methods to suppress nonnative fish, including centrachids, in Hills Creek Reservoir.

Odell Lake Core Area

1. Actions to Address Habitat Threats

1.1. Upland/Riparian Land Management

1.2. Instream Impacts

Transportation network (railroad grade)

1.2.1 <u>Assess stream habitat restoration potential</u>. Evaluate all tributaries of the core area, including Crystal Creek, Odell Creek and its tributaries, Davis Lake and its tributaries, for their potential to provide suitable bull trout habitat through active and passive restoration activities. Consider instream and near stream improvements.

1.2.2 <u>Identify and map suitable bull trout spawning and rearing habitat throughout Odell Lake Core Area</u>. Identify and map bull trout spawning habitat, present and potential, within the core area. Explore Odell Lake core area for all available and potential spawning areas.

1.2.3 Restore stream channels in Crystal Creek and Odell Creek to improve the quality of spawning habitat. Crystal Creek and Odell Creek provide adequate rearing habitat but are limited in high quality spawning areas. Stream substrates are predominantly fine and grainy sediments that are not suitable for spawning bull trout. Restore and improve spawning areas with gravel augmentation projects.

1.2.4 Improve side channel habitat on Trapper Creek to provide high quality rearing habitat. Trapper Creek is one of the few spawning areas in the basin, but lacks good rearing habitat for juveniles. Increase and improve rearing habitat in side channels.

1.3. Water Quality

2. Actions to Address Demographic Threats

2.1. Connectivity Impairment

2.2. Fisheries Management

Fisheries Management

2.2.1 Continue angler education and outreach efforts. Provide educational material to anglers on bull trout identification, habitat needs, special regulations, methods to reduce hooking mortality of bull trout caught incidentally, and the value of bull trout and their habitat. Utilize kiosks at campgrounds, posters, camp host, and lodge owners to distribute information.

2.2.2 Implement program to monitor trends in incidental catch of bull trout. Given the angling community in Odell Lake has been very helpful in the past, encourage lodge owners to report the catch of bull trout or employ the use of a volunteer angler survey at drop boxes at the lodges or kiosks.

2.3. Small Population Size

Genetic and Demographic Stochasticity

2.3.1 Assess the feasibility of establishing new populations(s) of bull trout in the Odell Lake Recovery Unit by way of intra or inter-basin translocation.

2.4. Forage Fish Availability

3. Actions to Address Nonnative Fishes

3.1 Nonnative Fish

Predation/Interspecific Competition

3.1.1 Evaluate the biological interaction between lake trout and bull trout. Compile empirical and circumstantial evidence to illustrate the putative negative effects of lake trout on bull trout population dynamics. In other recovery units and in Canada, the presence of lake trout results in the rapid decline of bull trout populations (Fredenberg 2002). In Odell Lake the direct relationship between lake trout and bull trout is only assumed. Given the extremely low numbers of bull trout in Odell Lake, direct measures of lake trout predation on bull trout are difficult, and unlikely, to obtain. Instead gather indirect and other empirical and circumstantial evidence, including results from ODFW's recent stable isotope study of the Odell Lake foodweb, to better describe the specific community level interaction between bull trout and lake trout.

3.1.2 Quantify lake trout demographics, seasonal habitat use, and spawning site selection including an abundance estimate.

3.1.3 Develop and implement a strategy to suppress lake trout. If the outcome of measure 3.1.1 strongly suggests lake trout impact bull trout then develop and implement a strategy to suppress and control the lake trout population in Odell Lake. Include information obtained in measure 3.1.2 as baseline data to monitor changes in the lake trout population relative to suppression efforts.

3.1.4 Develop outreach materials for lake trout suppression. Lake trout for the basis of a popular sport fishery on Odell Lake. If lake trout suppression is identified as an effective and appropriate management tool, then develop materials to educate Odell Lake anglers and recreational users about the issue and benefits of lake trout suppression to threatened bull trout.

Hybridization/Interspecific Competition

3.1.5 Where necessary and feasible, conduct eradication or control efforts in areas where spawning bull trout are sympatric with brook trout. Unnamed tributary #1 and other tributaries are priority areas as well as the headwaters of Trapper Creek.

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

Small Population Size

4.2.1 Develop an ongoing monitoring program to track population size. Maintain current long term datasets assessing abundance and distribution of bull trout. Consider employing new methods that may be more efficient and produce more reliable data. Continue to coordinate surveys among partner agencies.

4.3 Nonnatives

Hybridization

4.3.1 Periodically monitor hybridization status of bull trout and brook trout in tributaries where they co-occur.

Conservation Recommendations

- Inventory and eliminate sites of entrainment in summer home water intakes. To prevent juvenile entrainment, inventory commercial and residential pumps and determine if screens meet fish protection guidelines (*i.e.*, 5/16 inch (8 mm) mesh). Install appropriate screens where needed.

- Conduct formal analysis of railroad grade culvert on Crystal Creek to determine to what degree it blocks upstream passage of bull trout and other species. The railroad grade culvert in Crystal Creek is currently considered a barrier to upstream movement of bull trout. Upper fish distribution of multiple species ends at this point. Consider using U.S. Forest Service FishXing software program as an analytical tool. If the culvert is confirmed to be a barrier, restore passage to provide access to spawning and rearing habitat upstream of the culvert. However, prior to providing access, consider waiting and using the upstream habitat as a refuge, free from non-native fish, for the early phases of a possible re-introduction effort.

- Evaluate the natural falls on Trapper Creek to assess its role as a barrier to upstream migration. A natural falls exists on Trapper Creek in which upstream passage is in question. Upstream of the waterfall exists 7+ miles (11+ km) of high quality spawning and rearing habitat. Assess if the falls are a natural barrier to migration taking into consideration physical characteristics, such as height, jump-pool depth, and landing pad characteristics, and the distribution of bull trout. Thoroughly survey habitat upstream of the waterfall for the presence of bull trout methods such as eDNA detection, night snorkeling, or electrofishing surveys.

- Examine the interaction of bull trout and tui chub (*Gila bicolor*). Test thiaminase levels in tui chub. If present, test for transmission of thiaminase to bull trout. Consumption of flesh that contains thiaminase can lead to blindness and, therefore, starvation in predators.

Clackamas River Core Area

1. Actions to Address Habitat Threats

None

2. Actions to Address Demographic Threats

None

3. Actions to Address Nonnative Fishes

None

4. Research, Monitoring, and Evaluation

4.1 Habitat

4.2 Demographic

4.2.1 Continue to implement the Clackamas Bull Trout Reintroduction Implementation, Monitoring, and Evaluation Plan (USFWS and ODFW 2011). Collaborate with project partners to implement the reintroduction and monitor and evaluate project effectiveness, impacts to donor stock, and interactions with salmon and steelhead in the Clackamas River.

4.2.2 Replicate the 2009 baseline foodweb investigation. After Phase One of the project is complete (2016), replicate the baseline foodweb investigation that occurred in 2009 to determine the impact of the bull trout reintroduction on the Clackamas River foodweb (Lowery and Beauchamp 2010).

4.3 Nonnatives

Conservation Recommendations

- Promote interagency collaboration and coordination on bull trout recovery actions by supporting existing bull trout working groups or the formation of new bull trout working groups where they do not exist. While working groups may be facilitated by any interested stakeholder, most often they are organized and facilitated by the Service, a State agency, U.S. Forest Service, or a Tribal entity. Although the Service has no guidelines for format or process, existing working groups are largely informal, are organized at various scales (*e.g.*, core area, river basin, geographic region, or recovery unit) and generally meet at least annually.

- Increase information outreach to anglers. Provide information on bull trout identification, special regulations, methods to reduce hooking mortality of bull trout caught incidentally, and the value of bull trout and their habitat. Education and outreach designed to assist anglers in identifying and differentiating captured brook trout from bull trout is needed to reduced unintended take of bull trout.

- Conduct a genetic pedigree assessment to assess donor stock life stage contribution. At a future date, conduct a genetic assessment of naturally produced bull trout in the Clackamas River compared against fin clips taken from donor stock to assess which life stages contributed to the naturally produced population and perhaps which life stage was most effective in the reestablishment of bull trout in the Clackamas River.

Implementation Schedule for the Coastal Recovery Unit

The Implementation Schedule that follows describes recovery action priorities, action numbers, action descriptions, duration of actions, potential or participating responsible parties, total cost estimate and estimates for the next 5 years, if available, and comments. These tasks, when accomplished in conjunction with implementation of recovery actions in the other bull trout recovery units, will lead to recovery of bull trout in the coterminous United States as discussed in the Revised Draft Bull Trout Recovery Plan (USFWS 2014a).

Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the Implementation Schedule. Listing a responsible party does not imply that prior approval has been given or require that party to participate or expend any funds. However, willing participants will benefit by demonstrating that their budget submission or funding request is for a recovery action identified in an approved recovery plan, and is therefore part of a coordinated effort to recover bull trout. In addition, section 7(a)(1) of the Endangered Species Act directs all Federal agencies to use their authorities to further the purposes of the Act by implementing programs for the conservation of threatened or endangered species.

Threat Factor: Listing factor or threat category addressed by the recovery action.

A. The Present or Threatened Destruction, Modification or Curtailment of Bull Trout Habitat or Range;
B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes;
C. Disease or Predation;
D. The Inadequacy of Existing Regulatory Mechanisms; or
E. Other Natural or Manmade Factors Affecting Its Continued Existence

Recovery Action Priority: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

Priority 1: An action that must be taken to prevent extinction or prevent the species from declining irreversibly in the foreseeable future.

Priority 2: An action that must be taken to prevent a significant decline in species population or habitat quality.

Priority 3: All other actions necessary to meet the recovery objectives.

For reference we also list additional conservation recommendations. These actions are potentially beneficial for bull trout conservation and merit implementation, but they are not considered necessary to meet recovery objectives within a core area and so are not classified as Priority 1, 2, or 3. Conservation recommendations are not included in recovery cost estimates.

We evaluate recovery action priorities relative to the core area(s) where the action is targeted. Action priorities may reflect both the severity of the threat and the expected effectiveness of the action in addressing it.

Research, monitoring, and evaluation (RM&E) actions necessary for recovery are those deemed critical for developing information for planning, implementing, monitoring, and evaluating effectiveness of actions addressing management of primary threats. Depending on the level of importance of this information, these RM&E actions may be classified as Priority 1, 2, or 3. Other RM&E actions, while possibly informative and potentially contributing to recovery, may not be deemed necessary and will thus be classified as conservation recommendations.

Recovery Action Number and Description: Recovery actions as numbered in the recovery outline. Refer to the Narrative for action descriptions.

Recovery Action Duration: Indicates the number of years estimated to complete the action, or other codes defined as follows:

Continual (C) – An action that will be implemented on a routine basis once begun.

Ongoing (O) – An action that is currently being implemented and will continue until no longer necessary.

To be Determined (TBD) – The action duration is not known at this time or implementation of the action is dependent on the outcome of other recovery actions.

Responsible or Participating Party: Organizations listed are those with responsibility or capability to fund, authorize, or carry out the corresponding recovery tasks. Organizations with broader jurisdiction across multiple core areas are listed first, followed by organizations specific to particular core areas.

Bolded type indicates the agency or agencies that have the lead role for action implementation and coordination, though not necessarily sole responsibility.

BLM	U.S. Bureau of Land Management
BPA	Bonneville Power Administration
CTWS	Confederated Tribes of Warm Springs
ID	Irrigation districts
NMFS	National Marine Fisheries Service
NCNP	North Cascades National Park
NRCS	Natural Resources Conservation Service
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
ONP	Olympic National Park
PGE	Portland General Electric
PL	Private landowners
PSE	Puget Sound Energy
PSP	Puget Sound Partnership
USACE	U.S. Army Corps of Engineers
EPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WDOA	Washington Department of Agriculture
WDOE	Washington Department of Ecology
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WSDOT	Washington Department of Transportation

Chilliwack River Core Area

BCM	B.C. Ministry of Forests, Lands and Natural Resource Operations
DFO	Fisheries and Oceans Canada
FN	First Nations
NGO	Non-governmental organizations (*e.g.*, University of British Columbia and The Nature Conservancy)

Nooksack River Core Area

C	Whatcom County
C of B	City of Bellingham

NGO	Non-governmental organizations (*e.g.*, Whatcom Land Trust, Western Washington University, and Nooksack Salmon Enhancement Group)
TG	Tribal governments (Lummi Nation and Nooksack Tribe)

Lower Skagit River Core Area

C	Skagit County
NGO	Non-governmental organizations (*e.g.*, University of Washington, Skagit Salmon Enhancement Group, and Skagit Land Trust)
TG	Tribal governments (Sauk-Suiattle Tribe, Swinomish Tribe, and Upper Skagit Tribe)

Upper Skagit River Core Area

BCM	B.C. Ministry of Forests, Lands and Natural Resource Operations
NGO	Non-governmental organizations (*e.g.*, University of Washington and University of British Columbia)
SCL	Seattle City Light
SEEC	Skagit Environmental Endowment Commission

Stillaguamish River Core Area

C	Snohomish County
NGO	Non-governmental organizations (*e.g.*, University of Washington and Stilly Snohomish Fisheries Enhancement Task Force)
TG	Tribal governments (Stillaguamish Tribe of Indians, Tulalip Tribes)

Snohomish and Skykomish Rivers Core Area

C	Snohomish County
NGO	Non-governmental organizations (*e.g.*, University of Washington and Stilly Snohomish Fisheries Enhancement Task Force)
TG	Tribal governments (Tulalip Tribes)

Chester Morse Lake Core Area

NGO	Non-governmental organizations (*e.g.*, University of Washington)
SPU	Seattle Public Utilities

Puyallup River Core Area

C	Pierce County
MRNP	Mount Rainier National Park
NGO	Non-governmental organizations (*e.g.*, University of Washington, South Puget Sound Salmon Enhancement Group, and PCC Farmland Trust)
EH	Electron Hydro, LLC.
TG	Tribal governments (Muckleshoot Tribe and Puyallup Tribe)

Puget Sound Shared FMO

C	County governments
NGO	Non-governmental organizations (*e.g.*, University of Washington, Whidbey Camano Land Trust, and The Nature Conservancy)
TG	Tribal governments

Dungeness River Core Area

C	Clallam County
DMRT	Dungeness River Management Team
NGO	Non-governmental organizations (*e.g.*, University of Washington, South Puget Sound Salmon Enhancement Group, and PCC Farmland Trust)
TG	Tribal governments (Muckleshoot Tribe and Puyallup Tribe)

Elwha River Core Area

C	Clallam County
NGO	Non-governmental organizations (*e.g.*, University of Washington)
TG	Tribal governments (Lower Elwha Klallam Tribe)

Hoh River Core Area

C	Jefferson County
TG	Tribal governments (Hoh Tribe)

Queets River Core Area

C	Jefferson County
NGO	Non-governmental organizations (*e.g.*, University of Washington)
TG	Tribal governments (Quinault Nation)

Quinault River Core Area

C	Grays Harbor County
NGO	Non-governmental organizations (*e.g.*, University of Washington)
TG	Tribal governments (Quinault Nation)

Skokomish River Core Area

C	Mason County
SWAT	Skokomish Watershed Action Team
TG	Tribal governments (Skokomish Tribe)
TP	Tacoma Power

Olympic Peninsula Shared FMO

C	County governments
NGO	Non-governmental organizations (*e.g.*, University of Washington and The Nature Conservancy)
TG	Tribal governments

Lewis River Core Area

C	Skamania County
NGO	Non-governmental organizations (*e.g.*, University of Washington and Columbia Land Trust)
PC	PacifiCorp

Klickitat River Core Area

TG	Tribal governments (Yakama Nation)

Hood River Core Area

HRWG	Hood River Watershed Group
MFID	Middle Fork Irrigation District
SWCD	Soil and Water Conservation Districts

Lower Deschutes River Core Area

DBTWG	Deschutes Bull Trout Working Group
DWC	Deschutes Watershed Council
COID	Central Oregon Irrigation District
WC	Watershed Councils
WSPE	Warm Springs Power Enterprises

Upper Willamette River Core Area

EWEB	Eugene Water and Electric Board
OSP	Oregon State Police
UWBTWG	Upper Willamette Bull Trout Working Group

Odell Lake Core Area

UPR	Union Pacific Railroad
OLBTWG	Odell Lake Bull Trout Working Group
OSP	Oregon State Police
OWRD	Oregon Water Resources Department

Cost estimates: Estimated costs assigned to each action identified in the Implementation Schedule, both for the first 5 years after release of the recovery plan and for the total estimated cost of recovery (based on time to recovery, for Continual or Ongoing actions). Cost estimates are not provided for tasks which are normal agency responsibilities under existing authorities.

An asterisk (*) in the total cost column indicates ongoing tasks that are currently being implemented as part of normal agency responsibilities under existing authorities. Because these tasks are not being done specifically or solely for bull trout conservation, they are not included in the cost estimates. Some of these efforts may be occurring at reduced funding levels and/or in only a small portion of the watershed.

Time to Recovery: Estimated time before this recovery unit could meet recovery criteria, if recovery actions are successfully implemented.

Table A-2. Coastal Recovery Unit Implementation Schedule.

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Puget Sound Geographic Region													
Chilliwack River	A	1	1.1.1	Provide adequate protection of spawning and rearing streams	ongoing	**BCM**, DFO, NGO		*					
Chilliwack River	A	2	1.1.2	Restore instream channel and riparian conditions	TBD	BCM, DFO, NGO, FN		TBD					
Chilliwack River	B	3	4.2.1	Monitor angling impacts	periodic	**BCM**, NGO		*					
Nooksack River	A	2	1.1.1	Restore and protect riparian areas	TBD	**PSP, WDOE, WDOA, C,** NGO, TG, WDFW	Cost shared with salmon recovery	5,000					
Nooksack River	A	2	1.1.2	Complete Road Maintenance and Abandonment Plans	5	**WDNR, PL,** TG		TBD					
Nooksack River	A	1	1.3.1	Restore and protect groundwater and hyporheic sources in South Fork Nooksack River	TBD	**PSP, TG, C,** WDFW, USFWS	Cost shared with salmon recovery	9,600					
Nooksack River	A	2	2.1.1	Provide adequate fish passage around Bellingham Water Diversion	TBD	**C of B,** TG, WDFW, USFWS	Annual distribution dictated by project schedule	22,500					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Nooksack River	all	3	4.2.1	Establish spawning index area(s)	Annual or periodic	**WDFW, TG**, USFWS	For first 10 years	150		15		15	
Nooksack River	E	3	4.3.1	Assess impact of brook trout	TBD	**WDFW, USFS**		TBD					
Lower Skagit River	A	2	1.2.1	Reduce stream channel degradation and increase channel complexity	25	**PSP, C, USACE, WSDOT**, PL, TG, WDFW, NGO	Cost shared with salmon recovery	30,000					
Lower Skagit River	A	2	1.2.2	Practice non-intrusive flood control and flood repair activities	Ongoing	**PSP, USACE, WSDOT**, TG, WDFW, NMFS, USFWS	Some cost combined with 1.2.1	*					
Lower Skagit River	A	2	1.3.1	Restore and protect riparian areas	25 Protection will be continual	**PSP, C, PL**, NGO, WDOE, TG, WDFW, NMFS, USFWS	Cost shared with salmon recovery; possible land acquisition not included in cost estimate	15,000					
Lower Skagit River	A	1	1.3.2	Maintain and/or restore adequate instream flows	TBD	**PSP, C, PL, NGO**, TG, WDFW, NMFS, USFWS	Cost shared with salmon recovery	TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lower Skagit River	B, D	1	1.3.3	Implement adequate emergency measures to address climate change impacts	TBD	**WDFW, C, WDOE, TG**		*					
Lower Skagit River	E	1	1.3.4	Develop and implement restoration projects to minimize climate change impacts	TBD	**PSP, C, PL,** NGO, TG, WDFW, NMFS, USFWS		TBD					
Lower Skagit River	A	2	2.1.1	Ensure adequate fish passage at Baker River hydropower project	Continual	**PSE, WDFW, USFWS**, TG, NMFS	Implemented as per Settlement Agreement	*					
Lower Skagit River	A	3	4.1.1	Verify potential high water temperatures in upper Sauk River	TBD	**TG, NGO**, **USFS**, WDFW, NMFS, USFWS		TBD					
Lower Skagit River	all	3	4.2.1	Continue ongoing population monitoring efforts within the basin	Annual or periodic	**WDFW**		*					
Upper Skagit River	A	2	1.1.1	Provide adequate protection of spawning and rearing streams	TBD	**BCM**		*					
Upper Skagit River	A	2	1.2.1	Prevent or reduce impacts from recreational mining activities	Continuous	**BCM, WDFW**, NCNP, USFS		*					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Skagit River	A	2	1.3.1	Address contaminant exposure from Silver Daisy Mine	TBD	**BCM**		TBD					
Upper Skagit River	A	1	1.3.2	Prevent downstream contamination from Giant Copper Mine development	Continuous	**BCM, Imperial Metals Corp,** SEEC, NCNP, SCL		*					
Upper Skagit River	A	2	1.3.3	Address legacy impacts from industrial mining in Ruby Creek	TBD	**NCNP**		TBD					
Upper Skagit River	A	2	2.1.1	Ensure appropriate level of population connectivity	TBD	**SCL, WDFW, USFWS,** NCNP, NGO	Contingent on 4.2.1 results	TBD					
Upper Skagit River	E	2	3.1.1	Develop and implement brook trout removal/ suppression strategy	TBD	**BCM, NCNP, WDFW, SCL**	Cost may be greater depending on extent of threat	2,000					
Upper Skagit River	E	3	4.2.1	Evaluate the role and necessity of the local populations within Gorge and Diablo Reservoirs	2	**WDFW, USFWS, SCL**, NCNP, NGO		*					
Upper Skagit River	all	3	4.2.2	Continue ongoing population monitoring efforts within the basin	Annual or periodic	**BCM, NCNP**, WDFW, SCL, SEEC		*					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Skagit River	E	3	4.3.1	Monitor level of hybridization with brook trout and adjust removal/ suppression strategy accordingly	Periodic until no longer needed	**NCNP, SCL,** WDFW, BCM	Cost for ~ first 3 years	150					
Stillaguamish River	A	2	1.1.1	Reduce rate of anthropogenic landslides	25	**WDNR, C, PL**, PSP, TG	Cost shared with salmon recovery	18,000					
Stillaguamish River	A	2	1.2.1	Prevent or reduce impacts from recreational mining activities	Ongoing	**WDFW**, USFS, NMFS, USFWS		*					
Stillaguamish River	A	1	1.3.1	Implement restoration activities on forested lands to reduce water temperatures	25	**PSP, WDNR, PL, USFS**, TG, NGO	Cost shared with salmon recovery	35,000					
Stillaguamish River	A	1	1.3.2	Implement restoration and protection activities in development areas to reduce water temperatures	25	**PSP, C, PL, WSDOT**, TG, NGO, WDOE, WDFW	Cost shared with salmon recovery	25,000					
Stillaguamish River	A	2	2.1.1	Provide adequate passage at Cook Slough weir	TBD	**USACE, TG, NMFS, USFWS**	Cost shared with salmon recovery	TBD					
Stillaguamish River	A	1	2.1.2	Ensure continued upstream passage at Granite Falls fishway	Ongoing/ periodic	**WDFW**		*					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Stillaguamish River	A	1	2.3.1	Reestablish or enhance populations of bull trout in the Stillaguamish core area	TBD	**WDFW, USFS**, USFWS	Contingent on 4.2.1 results	TBD					
Stillaguamish River	A	1	4.2.1	Assess the feasibility of reestablishing or enhancing populations of bull trout in the Stillaguamish River core area	2-3	**WDFW, USFS, USFWS**, USGS	Divided over 2-3 years	200					
Stillaguamish River	all	3	4.2.2	Continue ongoing population monitoring efforts within the basin	Annual or periodic	**WDFW**		*					
Stillaguamish River	A	3	4.2.3	Evaluate alternative to Cook Slough Weir	2	**USACE, TG, NMFS, USFWS**		TBD					
Stillaguamish River	A	3	4.2.4	Conduct comprehensive assessment of Upper Deer Creek and Canyon Creek local populations	3	**WDFW, USFS, USFWS**, USGS		130		50	40	40	
Snohomish & Skykomish Rivers	A	2	1.2.1	Reduce stream channel degradation and increase channel complexity	25	**PSP, C, USACE**, **WSDOT**, PL, TG, WDFW, NGO	Cost shared with salmon recovery	30,000					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Snohomish & Skykomish Rivers	A	2	1.2.2	Practice non-intrusive flood control and flood repair activities	Ongoing	**PSP, USACE, WSDOT**, TG, WDFW, NMFS, USFWS	Some cost combined with 1.2.1	*					
Snohomish & Skykomish Rivers	A	2	1.2.3	Prevent or reduce impacts from recreational mining activities	Ongoing	**WDFW**, USFS, NMFS, USFWS		*					
Snohomish & Skykomish Rivers	A	1	1.3.1	Implement restoration and protection activities in development areas to reduce water temperatures	25	**PSP, C,** PL, TG, NGO	Cost shared with salmon recovery	15,000					
Snohomish & Skykomish Rivers	A	2	2.1.1	Ensure continued upstream passage at Sunset Falls	Ongoing/ periodic	**WDFW**, NMFS, USFWS		*					
Snohomish & Skykomish Rivers	all	3	4.2.1	Continue ongoing population monitoring efforts within the basin	Annual or periodic	**WDFW**		*					
Chester Morse Lake	A	1	2.1.1	Ensure future operations support connectivity	Continual	**SPU**, USFWS		*					
Chester Morse Lake	all	3	4.1.1	Continue ongoing population monitoring efforts within the basin	Annual or periodic	**SPU,** USFWS	May require additional funding to implement	TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Puyallup River	A	2	1.1.1	Implement restoration actions targeting unstable or problem roads	TBD	**USFS, WDNR, PL, MRNP**, WDFW		TBD					
Puyallup River	A	2	1.1.2	Complete Road Maintenance and Abandonment Plans	TBD	**WDNR, PL**		*					
Puyallup River	A	2	1.2.1	Reduce stream channel degradation and increase channel complexity	TBD	**PSP, C, USACE**, **WSDOT**, PL, TG, WDFW, NGO	Cost shared with salmon recovery	30,000					
Puyallup River	A	2	1.2.2	Practice non-intrusive flood control and flood repair activities	TBD	**PSP, USACE, WSDOT**, TG, WDFW, NMFS, USFWS	Some cost combined with 1.2.1	*					
Puyallup River	A	1	1.2.3	Ensure access to potential spawning and rearing refugia	TBD	**USFS, MRNP, C, WSDOT**, WDFW		TBD					
Puyallup River	A	1	1.2.4	Implement any additional mitigation strategies developed for glacial outburst impact	TBD	**MRNP, USFS, WDNR, C, PL**	Contingent on 4.1.1 and 4.1.2 results	TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Puyallup River	A	2	2.1.1	Provide adequate fish passage around Buckley Diversion and Mud Mountain Dam	TBD	**USACE, NMFS, USFWS**, TG, WDFW, PSP	Cost shared with salmon recovery	*					
Puyallup River	A	2	2.1.2	Provide adequate downstream passage around Electron Dam	TBD	**EH, TG, NMFS, USFWS,** WDFW, PSP	Cost shared with salmon recovery	TBD					
Puyallup River	A	1	2.3.1	Ensure protection of existing spawning areas in the Upper Puyallup and Mowich Rivers local population	TBD	**MRNP, USFS, PL, WDNR**, WDFW, TG, USFWS	Survey work would need to proceed protection efforts; also contingent on 4.2.1 results	TBD					
Puyallup River	E	2	3.1.1	Develop and implement brook trout removal/ suppression strategy	TBD	**MRNP, USFS WDFW,** USFWS, TG	Cost may be greater depending on extent of threat	2,000					
Puyallup River	E	3	4.1.1	Evaluate projected impacts from climate change induced glacial outbursts	TBD	**MRNP, USGS**, NGO		100					
Puyallup River	E	3	4.1.2	Evaluate projected impacts from climate change induced channel widening	TBD	**MRNP, USGS**, NGO		100					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Puyallup River	A, E	3	4.2.1	Determine limiting factors affecting abundance in the Upper Puyallup and Mowich Rivers local population	TBD	**MRNP, USFS**, USGS, NGO		150					
Puyallup River	A, E	3	4.2.2	Assess the feasibility of enhancing populations of bull trout in the Upper Puyallup and Mowich Rivers local population	TBD	**MRNP, USGS**, WDFW	Divided over 2-3 years when initiated	200					
Puyallup River	E	3	4.3.1	Monitor level of hybridization with brook trout and adjust removal/ suppression strategy accordingly	Periodic	**MRNP, USFS WDFW, USFWS**, TG, NGO		150					
Puget Sound Marine	A	1	1.1.1	Implement protection activities in nearshore marine and estuarine habitats	TBD	**PSP, C, NGO, PL, NMFS, USFWS, WDNR, TG, WDFW, WSDOT**	Cost shared with salmon recovery; likely $100s of millions	TBD					
Puget Sound Marine	A	2	1.1.2	Implement restoration activities in nearshore marine and estuarine habitats	TBD	**PSP, C, NGO, NMFS, USFWS, WDNR, TG, WDFW, WSDOT**	Cost shared with salmon recovery; likely $100s of millions	TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lake Washington	A, E	2	2.1.1	Address seasonal high water temperatures in Ship Canal	TBD	**USACE, PSP**, NMFS, TG, WDFW	Cost shared with salmon recovery	TBD					
Lower Green River	A	2	2.4.1	Restore freshwater preybase	TBD	**PSP, Green/ Duwamish Basin Recovery Partners**	Cost addressed under alternative programs; may not require full restoration to be adequately addressed	TBD					
Puget Sound Marine	A	3	4.4.1	Assess impacts of contaminants to anadromous bull trout	TBD	**USGS, USFWS, NGO**		200					
Puget Sound Marine	A	3	4.2.1	Assess importance of small independent streams to anadromous bull trout	TBD	**USFWS, USACE, NGO, USGS, WDFW**	Multi-year project	250					
Estimated cost subtotal, Puget Sound Geographic Region: $240,880,000 (over 25 years, minimum estimate)													
Olympic Peninsula Geographic Region													
Dungeness River	A	2	1.2.1	Reduce stream channel degradation and increase channel complexity	TBD	**PSP, DRMT, C, USACE**, PL, TG, WDFW, NGO	Cost shared with salmon recovery	5,000					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Dungeness River	A	2	1.2.2	Practice non-intrusive flood control and flood repair activities	TBD	**PSP, DRMT, USACE,** TG, WDFW, NMFS, USFWS	Some cost combined with 1.2.1	*					
Dungeness River	A	1	1.3.1	Improve instream flows	TBD	**PSP, DRMT, PL, WDOE,**	Cost shared with salmon recovery	TBD					
Dungeness River	A	1	2.3.1	Ensure protection of existing spawning areas in the Dungeness River and Gray Wolf River local populations	TBD	**USFS, ONP, WDNR**, WDFW, TG, USFWS		*					
Dungeness River	A	2	2.4.1	Restore freshwater preybase	TBD	**PSP, Dungeness Basin recovery partners**	Cost addressed under alternative programs; may not require full restoration to be adequately addressed	TBD					
Dungeness River	all	3	4.2.1	Establish spawning index area(s)	Annual or periodic	**WDFW, USFS**, USFWS	For first 10 years	150			15		15
Elwha River	A	2	1.2.1	Implement actions to improve fish passage at former dam sites	TBD	**ONP, TG**, USGS, NMFS, WDFW		*					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Elwha River	A	2	1.3.1	Implement actions to ensure adequate instream flows	Continual	**C, WDOE**, TG, NMFS, USFWS, ONP, PSP		*					
Elwha River	A	2	2.4.1	Restore freshwater preybase	TBD	**ONP**, TG, USGS, NMFS, WDFW, USFWS	~ 16 million to fully implement adaptive management program; ~7 million funded by NPS	*					
Elwha River	E	2	3.1.1	Develop and implement brook trout removal/ suppression strategy	TBD	**ONP, WDFW**, USFWS	Cost may be greater depending on extent of threat	200					
Elwha River	B	3	4.2.1	Monitor and evaluate fisheries impacts	Annual or periodic	**TG, WDFW, ONP**, NMFS, USFWS		*					
Elwha River	all	3	4.2.2	Establish spawning index area(s)	Annual or periodic	**ONP**		*					
Elwha River	E	3	4.3.1	Monitor level of hybridization with brook trout and adjust removal/ suppression strategy accordingly	Periodic until no longer needed	**ONP**, WDFW	Cost for ~ first 3 years	150					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Hoh River	A	2	1.1.1	Reduce transportation corridor impacts on mainstem river	TBD	**C, ONP**		25,000					
Hoh River	B	2	2.2.1	Ensure fisheries do not impede recovery	Annual or periodic	**TG, WDFW, ONP**		*					
Hoh River	B	3	4.2.1	Monitor and evaluate fisheries impacts	Annual or periodic	**TG, WDFW, ONP**		*					
Hoh River	all	3	4.2.2	Establish spawning index area(s)	Annual or periodic	**ONP**		*					
Queets River	A	2	1.1.1	Implement restoration actions targeting unstable or problem roads	TBD	**WDNR, USFS, TG**		TBD					
Queets River	B	2	2.2.1	Ensure fisheries do not impede recovery	Annual or periodic	**TG, WDFW, ONP**		*					
Queets River	B	3	4.2.1	Monitor and evaluate fisheries impacts	Annual or periodic	**TG, WDFW, ONP**		*					
Queets River	all	3	4.2.2	Establish spawning index area(s)	Annual or periodic	**ONP**, USGS, TG, WDFW		*					
Quinault River	A	2	1.1.1	Reduce transportation corridor impacts on mainstem river	TBD	**C, ONP, TG**	Some costs incorporated with 1.1.1	5,000					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Quinault River	A	2	1.1.2	Restore habitat complexity in Middle Reach	TBD	**TG, ONP, WDFW**		20,000					
Quinault River	B	2	2.2.1	Ensure fisheries do not impede recovery	Annual or periodic	**TG, WDFW, ONP**		*					
Quinault River	B	3	4.2.1	Monitor and evaluate fisheries impacts	Annual or periodic	**TG, WDFW, ONP**		*					
Quinault River	all	3	4.2.2	Establish spawning index area(s)	Annual or periodic	**ONP**, USGS, TG, WDFW		*					
Skokomish River	A	2	1.1.1	Implement restoration actions targeting unstable or problem roads	TBD	**USFS, SWAT**	Cost shared with salmon recovery	6,000					
Skokomish River	A	1	1.2.1	Reduce stream channel degradation and increase channel complexity	TBD	**PSP, C, USACE, SWAT**, PL, TG, NMFS, USFWS	Costs incorporated with 2.1.2; cost shared with salmon recovery						
Skokomish River	A	1	2.1.1	Ensure adequate fish passage at Cushman hydropower project on the North Fork Skokomish River	TBD	**TP, NMFS, USFWS**, TG, WDFW, ONP	Implemented as per Settlement Agreement	*					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Skokomish River	A	1	2.1.2	Implement actions to address channel aggradation on the mainstem and South Fork Skokomish Rivers	TBD	**PSP, USACE, TG, SWAT**, NMFS, USFWS	Cost shared with salmon recovery	40,000					
Skokomish River	B	2	2.2.1	Ensure fisheries do not impede recovery	Annual or periodic	**ONP, TG, WDFW**, NMFS, USFWS		*					
Skokomish River	A	1	2.3.1	Ensure protection of existing spawning areas in the South Fork Skokomish River local population	TBD	**USFS**, WDFW		TBD					
Skokomish River	A	2	2.4.1	Restore freshwater preybase	TBD	**PSP, Skokomish Basin recovery partners**	Cost addressed under alternative programs; may not require full restoration to be adequately addressed	TBD					
Skokomish River	A, E	3	4.2.1	Assess the feasibility of reestablishing or enhancing populations of bull trout in the Skokomish River core area	2-3	**WDFW, USFS, USGS**	Divided over 2-3 years when initiated	200					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Skokomish River	all	3	4.2.2	Continue ongoing population monitoring efforts within the basin	Annual or periodic	**ONP, WDFW**		*					
Skokomish River	B	3	4.2.3	Evaluate recreational fisheries impact in relation to recent shift in migratory timing	Annual or periodic	**ONP, WDFW**		*					
Strait of Juan de Fuca Marine	A	1	1.1.1	Implement protection activities in nearshore marine and estuarine habitats	TBD	**PSP, C, NGO, PL, NMFS, USFWS, WDNR, TG, WDFW, WSDOT**	Cost shared with salmon recovery; likely $10s of millions	TBD					
Strait of Juan de Fuca Marine	A	2	1.1.2	Implement restoration activities in nearshore marine and estuarine habitats	TBD	**PSP, C, NGO, NMFS, USFWS, WDNR, TG, WDFW, WSDOT**	Cost shared with salmon recovery; likely $10s of millions	TBD					
Pacific Coast Marine	A	2	1.1.3	Implement restoration actions in small independent tributaries	TBD	Washington Coast Sustainable Salmon Partnership		TBD					
Pacific Coast Marine	all	3	4.2.1	Establish overwintering index area(s)	Annual or periodic	**ONP, WDFW, TG**	Cost for first 10 years	200			20		20

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Pacific Coast Marine	B	3	4.2.2	Monitor and evaluate fisheries impacts	Annual or periodic	**TG, WDFW, ONP**, NMFS, USFWS		*					
Estimated cost subtotal, Olympic Peninsula Geographic Region: $101,900,000 (over 25 years, minimum estimate)													
Lower Columbia Geographic Region													
Lewis River	A	1	1.1.1	Accelerate natural recovery of key areas that benefit spawning or rearing habitat	TBD	**USFS**, USFWS, WDFW	Duration depends on response of natural environment	TBD					
Lewis River	A	2	1.1.2	Implement restoration and maintenance actions targeting unstable hillslopes or problem roads on private lands	Ongoing	**WDNR, C, PL**, WDFW,		TBD					
Lewis River	A	2	1.1.3	Addresses road maintenance needs on USFS lands	Ongoing	**USFS**, WDFW		TBD					
Lewis River	A	2	1.1.4	Increase efforts to preserve and protect key bull trout habitat from development and/or overuse	Continuous	**USFS, C, NGO, WDNR**, WDFW, USFWS		TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lewis River	A	2	1.1.5	Identify blockages in the basin, including recreational dams, and evaluate the impacts to bull trout rearing and spawning	TBD	**WDFW, USFS, WDNR, C, PL**	Contingent on identified blockages	TBD					
Lewis River	A	3	1.1.6	Use natural processes to improve instream structure and riparian habitat	TBD	WDNR, WDFW, C, PL		TBD					
Lewis River	A	2	1.2.1	Establish barrier nets at intakes on all three hydroelectric facilities	10	**PC, USFWS, NMFS, WDFW**	Implemented as per Settlement Agreement	*					
Lewis River	A, D	3	1.3.1	Monitor water withdrawals and diversions	Ongoing	**WDOE, PL**, WDNR, WDFW		*					
Lewis River	A	2	1.3.2	Work with County to manage forest conversion	Ongoing	**C, WDNR, PL, NGO**, WDFW, USFWS	Cost for potential acquisition not included	*					
Lewis River	A, D	2	1.3.3	Address impacts from residential and recreational development	Ongoing	**C, PL, NGO**, WDFW, USFWS	Cost for potential acquisition not included	*					
Lewis River	A, E	1	1.3.4	Increase protection of currently accessible cold water sources	TBD	**USFS, WDNR, C, NGO**, WDFW, USFWS, NMFS	Contingent on identified cold water sources	TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lewis River	A	1	2.1.1	Provide adequate upstream and downstream passage	15	**PC, USFWS, NMFS, WDFW**	Implemented as per Settlement Agreement	*					
Lewis River	A	1	2.1.2	Improve quantity and quality of habitat	Continual	**USFS, WDFW, PC**	PC ACC Aquatic Fund helps support this action	*					
Lewis River	B, D	2	2.2.1	Increase enforcement of fishery regulations	Ongoing	**WDFW, USFWS**	May require additional funding	*					
Lewis River	B	3	2.2.2	Increase efforts to inform anglers	Ongoing	**WDFW, USFWS**	May require additional funding	*					
Lewis River	A	1	2.3.1	Increase population size if less than demographic threshold	TBD	**WDFW, PC, USFWS**	Contingent on results from 4.2.4	TBD					
Lewis River	A	3	4.1.1	Conduct a climate change vulnerability assessment	TBD	**WDFW, USFS, USFWS**		TBD					
Lewis River	A, C	3	4.1.2	Evaluate impacts of reservoir drawdowns	Continual	**WDFW, PC, USFWS**, NMFS		*					
Lewis River	E	3	4.2.1	Monitor interactions between bull trout and reintroduced salmonids	Continual	**WDFW, PC, USFWS**, NMFS	Need overarching monitoring program	TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lewis River	A, E	3	4.2.2	Assess potential translocation of bull trout into coldwater sources not currently accessible	2-3	**WDFW, USFS**, USFWS, USGS	Divided over 2-3 years when initiated	200					
Lewis River	B	3	4.2.3	Monitor and evaluate fisheries impacts	Ongoing	**WDFW**, USFWS, NMFS		*					
Lewis River	all	2	4.2.4	Determine the demographic threshold (*i.e.*, minimum population size)	TBD	**WDFW, PC, USFWS**		TBD					
Lewis River	all	2	4.2.5	Evaluate population size as compared to the demographic threshold identified in action 4.2.4	TBD	**WDFW, PC, USFWS**		TBD					
Lewis River	all	3	4.2.6	Evaluate population abundance monitoring	Ongoing	**WDFW, PC, USFWS**	Need overarching monitoring program	TBD					
Lewis River	all	3	4.2.7	Continue genetic monitoring	Ongoing	**WDFW, PC, USFWS**	Need overarching monitoring program	TBD					
Lewis River	all	3	4.2.8	Expand spatial and temporal distribution monitoring	Ongoing	**WDFW, PC, USFWS**	Need overarching monitoring program	TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Klickitat River	B	2	3.1.1	Develop and implement brook trout removal/ suppression strategy	TBD	**WDFW, TG**	Cost may be greater depending on extent of threat	200					
Klickitat River	all	3	4.2.1	Establish spawning index area(s)	Annual or periodic	**WDFW, TG**, USFWS	For first 10 years	150			15		15
Klickitat River	B	3	4.3.1	Assess risk of hybridization with brook trout and adjust removal/ suppression strategy accordingly	Periodic	**TG, WDFW** USFWS		150					
Hood River	A	2	1.1.2	Restore instream channel conditions	15	**USFS**, **ODFW**, HRWG, NRCS, USFWS		2,000	50	50	50	50	50
Hood River	A	1	1.2.1	Improve Instream Flows	5	**MFID, USFS**		5,000	100	600	1000	2300	1000
Hood River	A	2	1.2.2	Improve Sediment Routing	2	**MFID, USFS**	In progress	40					
Hood River	A	2	1.2.3	Improve Wood Routing	Ongoing	**MFID, USFS**		25	5	5	5	5	5
Hood River	A	1	1.3.1	Improve water temperature below Laurance Lake during spawning period	5	**MFID, ODEQ**, USEPA, USFS, USFWS, USGS	In progress	5,000	100	600	1000	2300	1000

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Hood River	A	1	2.1.1	Restore Passage at Clear Branch Dam	5	**MFID, USFS,** ODFW, USFWS		3,000	500	1000	1000	250	250
Hood River	A	1	2.1.2	Secure instream flows and/or water rights	15	**ODFW,** USFS, ID, HRWG, WC, BPA		200	30	15	15	15	15
Hood River	A	1	2.1.3	Improve agricultural irrigation efficiency	6	**ID, HRWG, NRCS, SWCD**		300	50	50	50	50	50
Hood River	A	2	4.1.1	Continue to monitor for pesticides, herbicides and other toxic substances	Continual	**ODEQ, ODA,** HRWG, SWCD, CTWS		TBD	30	30	30	30	30
Hood River	A	1	4.2.1	Continue maintenance and operation of fish screens	Continual	**ODFW,** BPA**, USFWS, ID, MFID**		*					
Hood River	A, D	2	4.2.2	Continue ongoing population monitoring efforts	Continual	**ODFW, USFS**, CTWS, USFWS		TBD	1	1	1	1	1
Hood River	C	3	4.2.3	Monitor for disease and pathogens once passage at Clear Brand Dam is re-established	25	**ODFW**, CTWS, USFS, USGS, USFWS		125	5	5	5	5	5

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lower Deschutes River	E	3	4.2.1	Continue ongoing population monitoring efforts within the basin	Ongoing	**ODFW, USFS, USFWS, CTWS, DBTWG**	Cost covered under existing programs	*					
Lower Deschutes River	C	3	4.2.2	Continue to monitor angling impacts in the spring fishery of Lake Billy Chinook to ensure harvest of spawner population is limited and does not reduce population viability	Ongoing	**ODFW, CTWS, DBTWG, USFWS**		TBD					
Lower Deschutes River	E	3	4.2.3	Continue to monitor spawner and juvenile densities in the Warm Springs River, assess possible factors contributing to a depressed population	Ongoing	**CTWS, DBTWG**		TBD					
Lower Deschutes River	E	3	4.3.1	Assess and monitor distribution of brook trout and bull trout. Evaluate the degree of hybridization and competition where sympatry occurs	Ongoing	**ODFW, CTWS**, USFS, DBTWG	Partially covered under existing programs	45	15		15		15

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Willamette River	A	2	1.1.1	Develop and implement stream, riparian, and upland restoration projects that improve habitat for bull trout and spring Chinook salmon as an essential prey base	Ongoing	**USFS, ODFW, USACE, EWEB**, USFWS	Estimates for USFS McKenzie and EWEB only	3,480		300	2000	1000	180
Upper Willamette River	A	2	1.2.1	Identify environmental flow and wood, sediment, and nutrient supply improvement opportunities in the McKenzie and Middle Fork Willamette Rivers	TBD	**USACE, EWEB,** ODFW, USFWS	Costs included in 1.1.1	150			50	50	50
Upper Willamette River	A	2	1.2.2	Provide more normative water temperatures in Middle Fork Willamette River below Hills Creek where high temperatures affect bull trout during late summer and fall	TBD	**USACE,** USFWS, ODFW		TBD					
Upper Willamette River	A	2	2.1.1	Continue to document and evaluate entrainment of bull trout at Cougar, Trail Bridge, and Hills Creek dams as changes occur in reservoir operations	Ongoing	**USACE**, **EWEB**, ODFW, USFWS		TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Willamette River	A	1	2.1.2	Provide screening to prevent unsafe entrainment of bull trout through dams in the Upper Willamette core area (McKenzie and Middle Fork Willamette Rivers)	TBD	**USACE, EWEB,** ODFW, Private		TBD					
Upper Willamette River	A	1	2.1.3	Re-establish connectivity by providing safe upstream and downstream passage at Trail Bridge, Hills Creek, Lookout Point, and Dexter dams and downstream passage at Cougar Dam	TBD	**USACE**, **EWEB,** ODFW, USFWS, NMFS	Cost estimate for EWEB only	15,000				5000	10000
Upper Willamette River	A	1	2.1.4	Capture and move as appropriate bull trout holding below Hills Creek and Tail Bridge dams until upstream fish passage facilities are constructed and proven effective	Ongoing	ODFW, USFS, USACE, USFWS, EWEB		TBD	5	5	5	5	5

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Willamette River	B	1	2.2.1	Maintain a law enforcement presence in areas occupied by bull trout in order to ensure compliance with angling regulations, and concentrate patrols in known problem areas	Ongoing	**OSP, EWEB,** ODFW, USACE, USFS		TBD				80	80
Upper Willamette River	B	2	2.2.2	Continue public education and awareness through road signs, posters, pamphlets, presentations and information available on the internet	Ongoing	ODFW, USFS		TBD		5	5	5	5
Upper Willamette River	A	2	4.1.1	Monitor and evaluate the effectiveness of habitat restoration and enhancement projects	Ongoing	USFS, ODFW, USACE, EWEB, USFWS	Cost estimated for USFS - McKenzie	TBD		5	10	15	15
Upper Willamette River	A	2	2.4.1	Continue to provide historical prey base by outplanting excess live hatchery spring Chinook salmon into above dam habitats occupied by bull trout	Ongoing	**ODFW**, USFWS, ODEQ		TBD					

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Willamette River	all	2	4.2.1	Continue ongoing population monitoring efforts in all populations of the core area	Ongoing	**ODFW, USFS, USFWS**		TBD	15	15	15	15	15
Upper Willamette River	all	2	4.2.2	Continue to monitor and evaluate the status of Middle Fork Willamette River bull trout population	Ongoing	**ODFW**, USACE, USFS, USFWS		TBD					
Odell Lake	E	2	2.3.1	Assess the feasibility of establishing new populations(s) of bull trout in the Odell Lake Recovery Unit by way of intra or inter-basin translocation	1	ODFW USFS USFWS		2	2				
Odell Lake	E	1	3.1.1	Evaluate the biological interaction between lake trout and bull trout	5	**ODFW**		261		130	130	10	
Odell Lake	E	2	3.1.2	Quantify lake trout demographics, seasonal habitat use, and spawning site selection	2	ODFW		TBD					
Odell Lake	E	2	3.1.3	Develop and implement a strategy to suppress lake trout	2	**ODFW,** USFS, USFWS, private parties		50			25	25	

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Odell Lake	E	3	3.1.4	Develop outreach materials for lake trout suppression	TBD	**ODFW, USFS, OLBTWG**		TBD					
Odell Lake	E	2	3.1.5	Conduct eradication or control efforts in areas where spawning bull trout are sympatric with brook trout	TBD	ODFW, USFS		250	10	15	10	10	
Odell Lake	E	3	4.2.1	Develop an ongoing monitoring program to track population size	TBD	ODFW, USFWS, USFS, OLBTWG		TBD					
Odell Lake	E	3	4.3.1	Periodically monitor hybridization status of bull trout and brook trout in tributaries where they co-occur	25	USFS ODFW	Ongoing, covered under existing programs	TBD					
Clackamas River	E	1	4.2.1	Continue to implement the Clackamas Bull Trout Reintroduction Implementation, Monitoring and Evaluation Plan	20	**ODFW**, USFS, **USFWS**		400	80	80	80	80	80
Clackamas River	E	3	4.2.2	Replicate the 2009 baseline foodweb investigation	1	**ODFW**, **USFWS**		200			200		

Core Area	Threat Factor	Recovery Action Priority	Recovery Action Number	Recovery Action Description	Recovery Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Estimated cost subtotal, Lower Columbia Geographic Region: $37,218,000 (over 25 years, minimum estimate)													
Estimated total cost of recovery actions within this recovery unit: $379,998,000 (over 25 years, minimum estimate)													
Time to Recovery (estimated time required to meet recovery criteria within this recovery unit): **25 years (3-5 bull trout generations)**													

Conservation Recommendations for the Coastal Recovery Unit

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Puget Sound Geographic Region													
Chilliwack River	A, B	Cons Rec		Conduct research to verify suspected presence of anadromous life history and associated migratory patterns		**NGO**, BCM							
Chilliwack River	all	Cons Rec		Develop spawning index area(s) in local populations both within British Columbia and U.S. or other appropriate surrogate to provide capability of monitoring population trend of the core area		**BCM, NCNP,** USFWS							
Nooksack River	A	Cons Rec		Implement all recovery actions identified in WRIA 1 Salmonid Recovery Plan	Until salmon and steelhead recovery achieved	**PSP, Nooksack Basin recovery partners**	Cost addressed under alternative programs						
Nooksack River	E	Cons Rec		Develop and implement a proactive brook trout removal/suppression strategy in key local populations		**WDFW, USFS**							

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lower Skagit River	B	Cons Rec		Refine angling regulations as appropriate		**WDFW, TG,** USFWS							
Lower Skagit River	E	Cons Rec		Develop and implement a proactive brook trout removal/suppression strategy		**WDFW, USFS**, USFWS							
Lower Skagit River	A	Cons Rec		Implement all recovery actions identified in Skagit Chinook Recovery Plan	Until salmon and steelhead recovery achieved	**PSP, Skagit Basin recovery partners**	Cost addressed under alternative programs						
Upper Skagit River	E	Cons Rec		Periodic monitoring of redside shiner impact to ecosystem		**NCNP, SCL,** WDFW, BCM, NGO							
Stillaguamish River	A	Cons Rec		Implement all recovery actions identified in Stillaguamish Watershed Chinook Recovery Plan	Until salmon and steelhead recovery achieved	**PSP, Stillaguamish Basin recovery partners**	Cost addressed under alternative programs						
Snohomish & Skykomish Rivers	A	Cons Rec		Implement all recovery actions identified in Snohomish River Basin Salmon Conservation Plan	Until salmon and steelhead recovery achieved	**PSP, Snohomish Basin recovery partners**	Cost addressed under alternative programs						
Snohomish & Skykomish Rivers	B	Cons Rec		Refine angling regulations as appropriate		**WDFW, TG,** USFWS		*					

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Chester Morse Lake	E	Cons Rec		Monitor spawning and rearing habitat distribution, condition, and use overtime to determine any significant adverse changes as a result of anticipated climate change impacts		**SPU**, USGS, NGO							
Puyallup River	A	Cons Rec		Implement all recovery actions identified in Salmon Habitat Protection and Restoration Strategy for the Puyallup watershed	Until salmon and steelhead recovery achieved	**PSP, Puyallup Basin recovery partners**	Cost addressed under alternative programs						
Olympic Peninsula Geographic Region													
Dungeness River	A	Cons Rec		Implement all recommended protection and restoration actions identified in various salmon and watershed recovery planning documents for the Dungeness watershed	Until salmon and steelhead recovery achieved	**PSP, Dungeness Basin recovery partners**	Cost addressed under alternative programs						
Hoh River	A	Cons Rec		Implement all recommended actions and management strategies identified in WRIA 20 Watershed Management Plan		**Washington Coast Sustainable Salmon Partnership**	Cost addressed under alternative programs						

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Queets River	A	Cons Rec		Implement all recommended actions identified in the WRIA 21 Salmon Habitat Recovery Strategy		**Washington Coast Sustainable Salmon Partnership**	Cost addressed under alternative programs						
Quinault River	A	Cons Rec		Implement all recommended actions identified in the WRIA 21 Salmon Habitat Recovery Strategy		**Washington Coast Sustainable Salmon Partnership**	Cost addressed under alternative programs						
Skokomish River	A	Cons Rec		Implement all recommended actions under habitat recovery strategies identified in Recovery Plan for Skokomish River Chinook Salmon	Until salmon and steelhead recovery achieved	**PSP, Skokomish Basin recovery partners**	Cost addressed under alternative programs						
Pacific Coast Marine	A	Cons Rec		Implement all recommended management strategies and actions identified in the Washington Coast Sustainable Salmon Plan		Washington Coast Sustainable Salmon Partnership	Cost addressed under alternative programs						
Chehalis River/ Grays Harbor	E	Cons Rec		Assess potential for "re-establishing" a natal population of bull trout to the Satsop River watershed in the Chehalis Basin	2-3	**USFS, USGS**, WDFW	Divided over 2-3 years when initiated						

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lower Columbia Geographic Region													
Lewis River	A	Cons Rec		Develop and implement a proactive brook trout removal/suppression		**WDFW, USFS**							
Klickitat River	A	Cons Rec		Ensure key bull trout habitats in the West Fork Klickitat River are protected from development or overuse		**TG**							
Hood River	B	Cons. Rec		Refine angling regulations	Ongoing	**ODFW**, USFWS		50	2	2	2	2	2
Hood River	E	Cons Rec		Research extent of use of the Columbia River FMO	25	**ODFW, WDFW, USFWS,** BPA, USACE		500	50	50	50	50	50
Hood River	E	Cons Rec		Monitor and assess upstream movement of bull trout past two newly created falls on Middle Fork Hood River		**ODFW, USFS, CTWS, USFWS**							
Lower Deschutes River	A	Cons Rec		Continue implementation of the long-term passage plan at the Pelton-Round Butte hydro project to provide upstream and downstream passage of bull trout	Ongoing	**PGE, WSPE**	Cost covered under existing programs	*					

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Lower Deschutes River	A	Cons Rec		Continue ongoing maintenance and operation of fish screens at water diversions and irrigation ditches	Ongoing	**ID's, private irrigators**, ODFW, USFWS	Partially covered under existing programs.						
Lower Deschutes River	A	Cons Rec		Continue to implement all land management plans and Best Management Practices to ensure continued protection and enhancement of bull trout habitat	Ongoing	**USFS, BLM, CTWS, ODF, ODA, ODEQ**	Cost covered under existing programs	*					
Lower Deschutes River	C	Cons Rec		Where necessary and feasible, adaptively manage bull trout and kokanee harvest in Lake Billy Chinook. Provide management agencies the flexibility to manage harvest and angling to best meet the needs of the lower Deschutes bull trout populations	Ongoing	**ODFW, CTWS, USFWS**	Cost covered under existing programs	*					
Lower Deschutes River	E	Cons Rec		Where necessary and feasible, implement management actions to reduce distribution and abundance of brook trout	Ongoing	**ODFW, CTWS,** USFS, BTWG	Partially covered under existing programs.	15	3	3	3	3	3

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Willamette River		Cons Rec		Regularly update watershed analyses for subbasins currently occupied by bull trout		**USFS**							
Upper Willamette River		Cons Rec		Continue to monitor and identify existing road systems that have a high risk of adversely affecting bull trout habitat	Ongoing	**USFS**							
Upper Willamette River		Cons Rec		Continue to operate Cougar Dam upstream fish passage facility (trap and haul)		USACE, ODFW							
Upper Willamette River		Cons Rec		Continue maintenance and operation of fish screens on Leaburg-Walterville Hydroelectric facility and Cougar Dam Penstock		**USACE, EWEB**							
Upper Willamette River		Cons Rec		Assess threats to bull trout from hybridization, competition, and predation by brook trout, and if appropriate and feasible, implement control of brook trout		**ODFW, USFS**, EWEB, USFWS							

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Upper Willamette River		Cons Rec		Continue to assess threats to bull trout from predation and competition by nonnative fish		**ODFW, USACE, EWEB**							
Upper Willamette River		Cons Rec		Identify and prioritize for correction manmade barriers that impede bull trout access to suitable habitat.		**USFS**, **ODOT, USACE**, EWEB	This task applies primarily to culverts at road crossings						
Odell Lake	A	Cons Rec		Inventory and eliminate sites of entrainment in summer home water intakes				10		10			
Odell Lake	A	Cons Rec		Conduct formal analysis of railroad grade culvert on Crystal Creek to determine to what degree it blocks upstream passage of bull trout and other species				5		5			
Odell Lake	E	Cons Rec		Evaluate the natural falls on Trapper Creek to assess its role as a barrier to upstream migration				10		10			
Odell Lake	E	Cons Rec		Examine the interaction of bull trout and tui chub									

Core Area	Threat Factor	Action Priority	Action Number	Action Description	Action Duration	Responsible Parties	Comments	Estimated Costs (x $1,000)					
								Total Cost	FY 15	FY 16	FY 17	FY 18	FY 19
Clackamas River		Cons Rec		Promote interagency collaboration and coordination on bull trout recovery actions by supporting existing bull trout working groups or the formation of new bull trout working groups where they do not exist	Ongoing	**USFWS,** PGE, **ODFW**, USFS, NMFS, CTWS							
Clackamas River		Cons Rec		Increase information outreach to anglers	Ongoing	**ODFW,** USFS, USFWS							
Clackamas River		Cons Rec		Conduct a genetic pedigree assessment to assess donor stock life stage contribution.	1	**USFWS, ODFW**		Unknown					

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