BIOLOGICAL EVALUATION

MAINTENANCE DREDGING,

SNOHOMISH RIVER NAVIGATION CHANNEL, DOWNSTREAM AND UPSTREAM SETTLING BASINS,

EVERETT, WASHINGTON

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1 INTRODUCTION

This Biological Evaluation (BE) addresses the effects of U.S. Army Corps of Engineers (Corps) routine maintenance dredging of the downstream and upstream settling basins and portions of the navigation channel in the Snohomish River, Everett, Washington, beginning in FY2012. This BE addresses fish and wildlife species that are protected under the Endangered Species Act (ESA) of 1973 and under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), collectively referred to hereafter as the Services. This BE specifically addresses species that are listed, proposed, or candidates for listing under the ESA that may potentially occur within the lower Snohomish River, including the vicinity of Jetty Island.

The most recent informal consultation with the Services occurred in 2009: the Corps submitted a BE on September 30, 2009, addressing the maintenance dredging that occurred in fiscal years (FYs) 2010 and 2011. USFWS provided a concurrence letter for this project on November 19, 2009. NMFS concurred in a letter of November 23, 2009.

Some of the dredged sediment would be disposed of at the Washington Department of Natural Resources (WDNR) managed Puget Sound Dredged Disposal Analysis (PSDDA) open-water, non-dispersive disposal site at Port Gardner. Both USFWS and NMFS have concurred (USFWS 2005; NMFS 2005a; NMFS 2007c) with effect determinations related to disposal of dredged material at the PSDDA open water site at Port Gardner, as presented in the Programmatic Biological Evaluations prepared for the PSDDA Non-Dispersive Disposal Sites (USACE 2005; USACE 2007a and 2007b). NMFS has concurred with Essential Fish Habitat consultation for the PSDDA open water disposal sites (NMFS 2005). The latest PSDDA consultation is based on a BE written in August 2010, and concluded with receipt of a biological opinion from NMFS dated December 22, 2010, and a concurrence letter from USFWS dated January 11, 2011.

Therefore, because of the limited duration of coverage from the 2009 consultation, this BE updates the 2009 BE for the proposed dredging operations, and upland disposal associated with those operations, in the Snohomish River Navigation Channel (see Section 3), and will not address transport of material to and disposal of material at the Port Gardner open water disposal site.

1.1 Authority

This dredging project, adopted June 25, 1910 and modified by subsequent acts, consists of navigation channels, two settling basins, and dikes to serve navigation in Everett Harbor and the Snohomish River. Federal maintenance dredging is required within the lower 6.6 miles of the Snohomish River to remove annually shoaling river sediments. The overall navigation project includes:

(1) a one-mile channel from Puget Sound up the Snohomish River, 15 feet deep at mean lower low water (MLLW) and 150 to 425 feet wide.

(2) an upper channel extending to river mile 6.6, 8 feet deep at MLLW and 150 feet wide.

(3) two settling basins in the river channel;

a. the downstream basin with 250,000 cubic yards (cy) capacity

b. the upstream basin with 1 million cy capacity.

1.2 Project Location

The Snohomish River navigation channel is the downstream reach of the Snohomish River system to which the Pilchuck, Skykomish, and Snoqualmie Rivers are the largest tributaries. The proposed dredging project encompasses the lower 6.6 miles of the river channel and includes the downstream settling basin, upstream settling basin and the adjacent portions of the navigation channel, as well as several upland disposal sites along the shoreline of the lower Snohomish River (Figures 1 and 2).

The downstream settling basin was developed by the Corps to catch sediment and reduce the frequency of dredging required to maintain safe navigation in the lower Snohomish River. The basin is 700 feet wide, 1,200 feet long, and 20 feet deep; the channel to the south narrows to a width of approximately 425 feet, then narrowing further to ultimately become the 150-foot wide navigation channel at a depth of 15 feet (i.e., an elevation of -15 feet mean lower low water [MLLW]) (Figure 1). The navigation channel extends upstream from the downstream settling basin for a distance of approximately 5.5 miles at a depth of 8 feet and a width of 150 feet. The upstream settling basin is approximately 150 feet wide, 2,112 feet long and is usually dredged to a depth of 30 feet (although its authorized depth is 40 feet deep). The navigation channel extends upstream from the upstream settling basin for another approximately 0.5 miles at a depth of 8 feet and a width of 150 feet (Figure 1). The PSDDA site in Port Gardner is located at 47 degrees 58.85 minutes north latitude and 122 degrees 16.67 minutes west longitude (NAD27) (Figure 3).

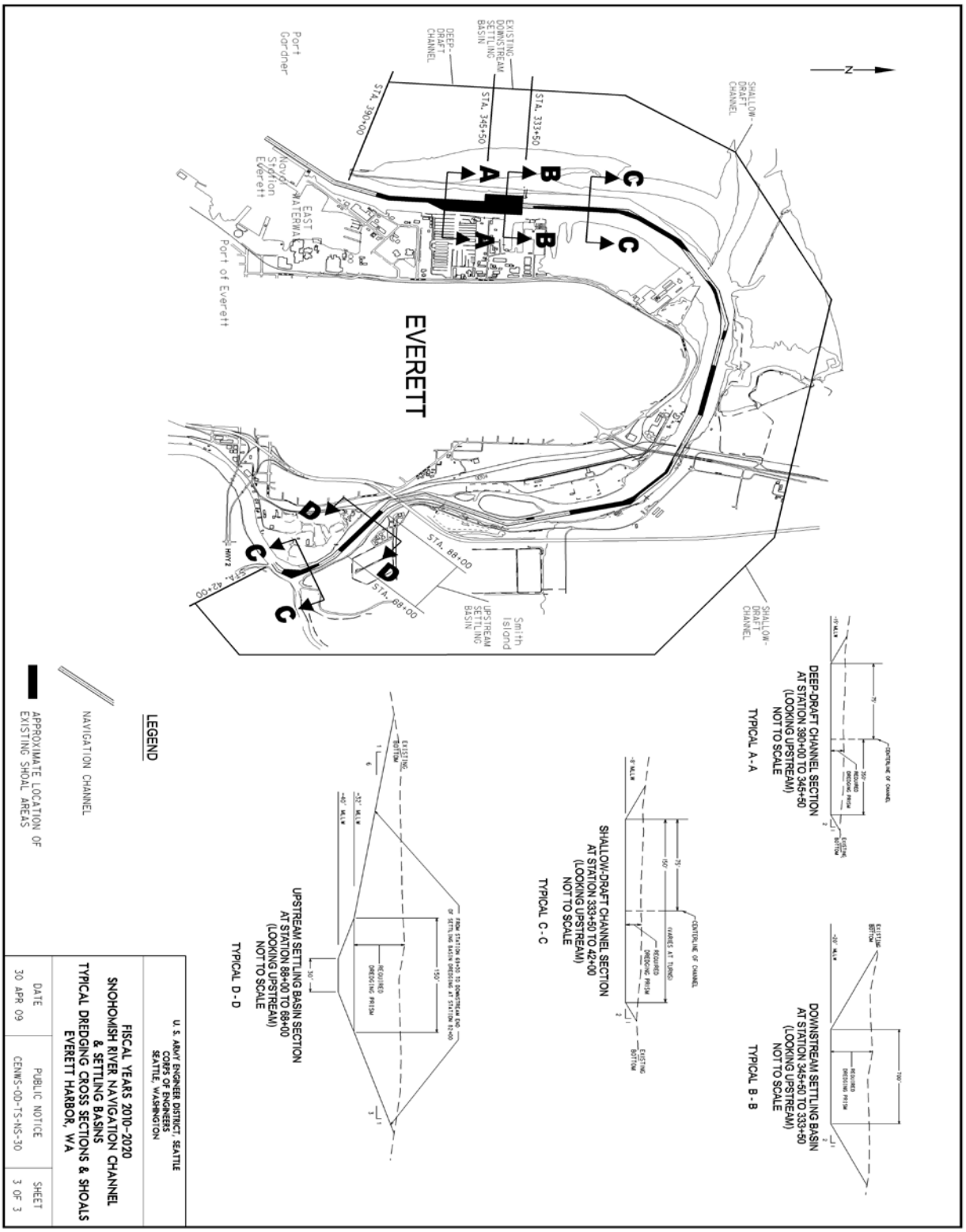

Figure 1: Extent of dredging in upper and downstream settling basins and navigation channel.

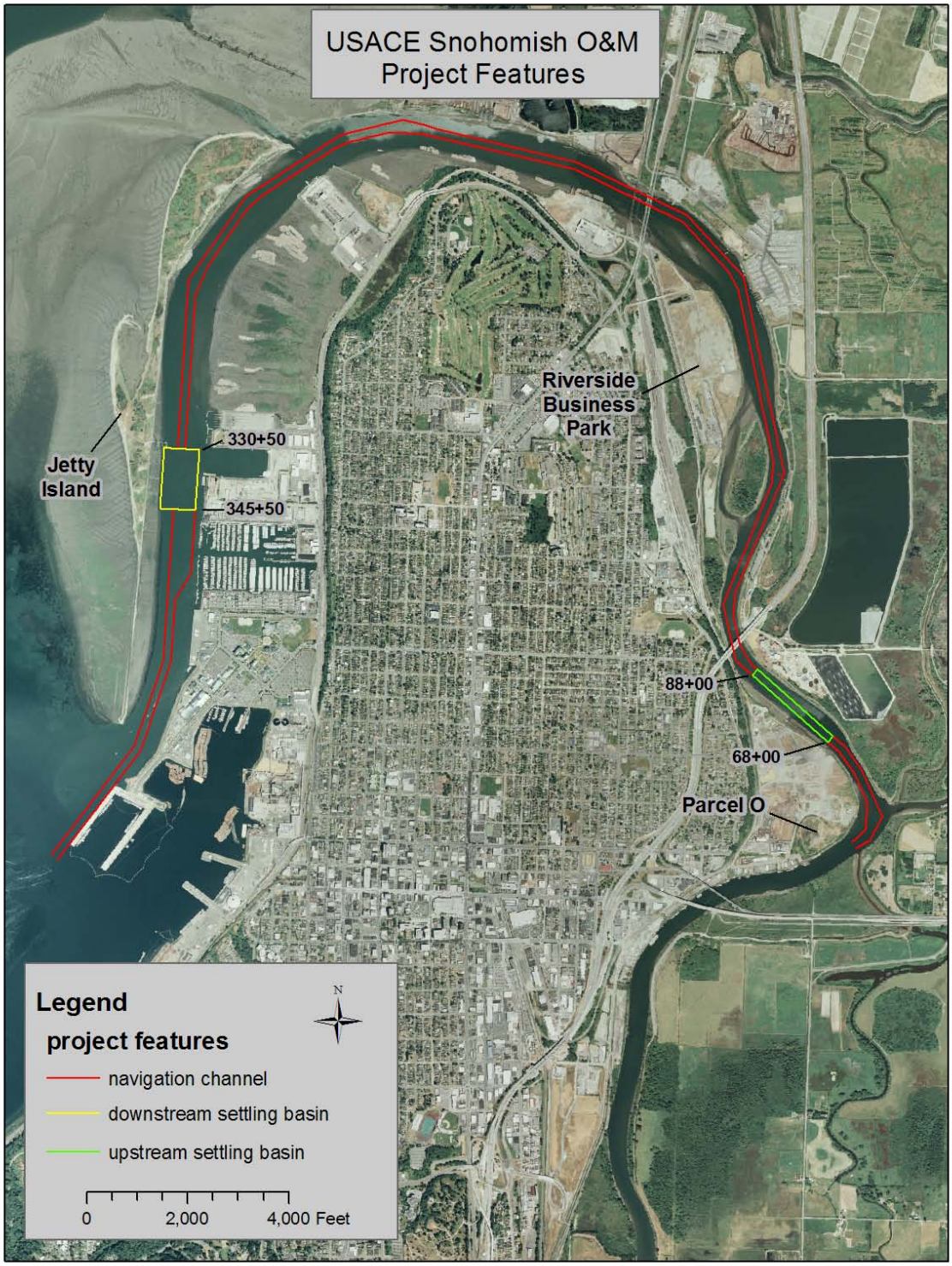

Figure 2: Project features, including upland disposal areas

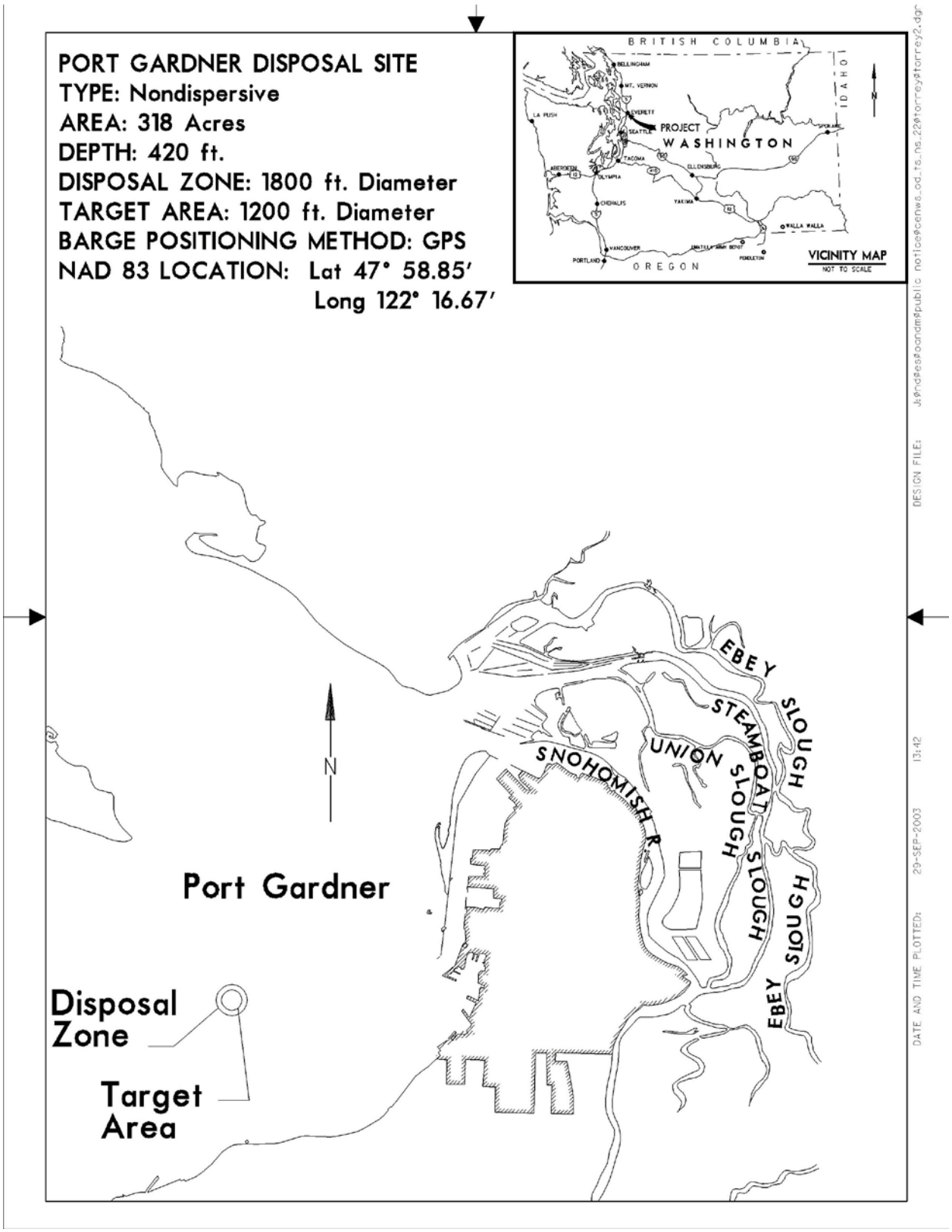

Figure 3: Vicinity Map, showing Snohomish River Estuary, Port Gardner, and PSDDA Site

1.3 Definition of Project and Action Areas

The action area, i.e., the area affected directly or indirectly by the dredging project, is defined as the lower Snohomish River, Jetty Island and its adjacent habitats, and Port Gardner Bay (Figures 2 and 3). The project area consists of the areas actually dredged within the navigation channel and settling basins, and the upland disposal sites.

2 DESCRIPTION OF PROJECT AREA AND ACTION AREA

2.1 Snohomish River and Estuary

The Snohomish River estuary is approximately 9 miles long and three to four and a half miles broad at its widest point. The shoreline along the lower Snohomish River is moderately developed with maritime industry, commercial recreation and undeveloped areas of intertidal and freshwater wetlands and associated uplands.

The Port of Everett is a major exporter of logs to Asia, and the Port also supports the U.S. Naval Station Everett, home to the USS Abraham Lincoln, numerous support ships, and some 2,400 naval personnel. The Everett Marina at the southern end of the navigation channel is the largest in the Pacific Northwest and the second largest on the west coast, supporting some 2,300 boats. The downstream settling basin is immediately west of the Everett Marina (Figure 2).

The navigation channel is thus subject to intense marine traffic ranging from commercial vessels, including commercial fishing, as well as recreational boaters, sports anglers and hand-launch kayakers and canoeists. While much of the intertidal zone has been historically diked and drained to accommodate agricultural and commercial development, large areas of undeveloped habitat remain on the estuary's six major islands, particularly on Spencer, Otter, and South Ebey Island, all of which are located upstream of the upstream settling basin (Figure 3).

2.2 Jetty Island and Offshore Eelgrass Beds

Creation of the Jetty Island began in 1903 with construction of a rock jetty behind which dredged materials from the navigation channel could be placed. Maintenance of the channel and placement of the dredged material to build the island continued until 1969. In the 1980s the Corps increased the area of habitat created on Jetty Island by continuing to beneficially use dredged material from the downstream settling basin and navigation channel. The Corps and the Port of Everett placed approximately 323,000 cubic yards of clean sediment along the western portion of the island from October through December 1989 as a 1,500-foot long berm to balance erosion losses from the west side of the island and to create protected intertidal marsh and mudflat habitat. The berm was planted in the spring of 1990 and again in 1991 with native saltmarsh vegetation (above +9 feet MLLW). Subsequent natural colonization of salt-tolerant upland plant species has also occurred above +12 feet MLLW. Once this 15-acre berm was created, a 19-acre mudflat formed within the protected embayment (Pentec 2000). A natural sand spit and an area of saltmarsh also subsequently formed off the northern tip and eastern side of the berm.

Monitoring by Pentec Environmental (Pentec) from 1990 through 1995 demonstrated that the berm had created functional habitat as evidenced by: a higher abundance of epibenthic zooplankton (i.e. juvenile salmonid prey species) inside the depositional mudflat formed by the berm, juvenile salmon and juvenile surf smelt use of the area during high tides, and migrating shorebirds intensively using the mudflat (Pentec 2000). The berm thus created valuable mudflat habitat for benthic infauna and epibenthic crustaceans, which improved the food supply and habitat value of Jetty Island for juvenile salmon, forage fish, and shore birds.

However, since there is no natural source of sediment to nourish the berm, the life of the berm and the habitat it protects is limited without periodic replacement of eroded material with new sediment. The area of saltmarsh that had developed inside of the sand spit was largely obliterated in 1997 during overtopping storms that deposited over two feet of sand onto the marsh. In January 1998, the Corps placed an additional approximately 81,000 cubic yards of clean sediment from maintenance dredging on the berm (top of bank to the +5 to +6 foot contour) to partially address overtopping by storms (Pentec 2000). However, the quantity of material placed in 1998 was insufficient to replace all the material that had eroded, particularly along the northern half of the berm. As of 1999, the berm had lost an estimated 98,000 cubic yards of sediment. Approximately 10 percent (or 10,000 cubic yards) of sediment was transported northward and deposited on the distal end of the berm. The rest of the sediment (approximately 80,000 cubic yards) was presumably carried offshore. Fortunately, the winter of 1999 to 2000 was unusually mild and little additional erosion was experienced along the berm during that time. By summer 2000, the berm showed a loss of material from its outer half and additional nourishment was planned to maintain the integrity of the berm and the habitat values that had developed within the sheltered lagoon it forms (Pentec 2003). Between January 14 and 18, 2002, approximately 30,000 cubic yards of material from the channel upstream of the downstream settling basin was hydraulically placed on Jetty Island for renourishment of the berm. Sediment was placed in a configuration that preserved the existing area of mudflat and saltmarsh habitat while widening and strengthening the berm, but not extending its length (Pentec 2003). Continuing renourishment of the berm will be necessary to prevent the gradual erosion of the berm and to thus maintain the habitats created by the berm.

A large eelgrass meadow exists off the west shore of Jetty Island. Pentec estimated that the area west of Jetty Island which could support eelgrass was approximately 1,284 acres in size, based on preliminary video mapping (Pentec 1996). A photographic and underwater video mapping effort conducted in 2000 (Pentec 2001) showed that the largest continuous eelgrass meadow lies just west of the south end of Jetty Island. Eelgrass to the west and north of this area consists of discontinuous patches that are divided by meandering distributary channels of the Snohomish River as it flows over its delta at low tide (Pentec 2003).

2.2.1 Alternative Upland Disposal Sites

Sediment dredged from the upstream settling basin and channel could be used if needed at several previously utilized upland disposal sites, including the Port of Everett's Riverside Business Park site and the City of Everett's Parcel O site (Figure 2). These upland sites are all located along the lower Snohomish River and have used dredged sediments from the upstream

settling basin and adjacent upstream portion of the navigation channel in the past. The future use of these sites is dependent upon the need for materials at these sites.

3 DESCRIPTION OF PROPOSED ACTIONS

3.1 Dredging

The navigation channel within the Snohomish River upstream of the downstream settling basin extends upstream approximately 6.6 miles at a depth of 8 feet and a width of 150 feet (Figures 1 and 2). The downstream settling basin is 20 feet deep, while the navigation channel downstream of the basin is 15 feet deep. The proposed action includes dredging and disposal operations to be performed annually for the next seven years. This time-frame is established by the Dredged Material Management Program (DMMP) agencies, based on the "frequency guidelines", which provide a period of 5 to 7 years between sediment testing (see section 3.2.1 for additional information). In even-numbered fiscal years, beginning with FY2012, the downstream basin and adjacent navigation channel would be dredged; in odd-numbered fiscal years, beginning in FY 2013, the upstream basin and adjacent navigation channel and segments within the intermediate reach would be dredged. The dredging and disposal activities would be performed between October 16 and February 14 of each fiscal year and would generally be accomplished within sixty to ninety days. Dredging is performed within this window in order to minimize disturbance to migrating juvenile salmonids.

Unfortunately, this window coincides with the upstream migration of steelhead adults, particularly later in this period (i.e., December-February). To alleviate this concern, the Port of Everett and the Corps conducted two noise monitoring studies during dredge operations to determine whether the noise generated by operating dredges was sufficient to harm or disturb migrating steelhead and other salmonids (Pentec Environmental 2010; SAIC 2011) (see discussion in section 5.2.3).

Details regarding the anticipated volumes of dredged materials, the types of equipment used, and the propose use or disposal of the dredged sediment are determined based on annual condition surveys conducted in the spring prior to the proposed dredging. Therefore, approximate volume information and details regarding the types of dredging equipment and disposal options are based upon the past dredging activities, which accomplished dredging and disposal annually of up to 500,000 cy of material. Actual volumes dredged are controlled by funding available and disposal site capacity/availability.

3.1.1 Dredging of Downstream Settling Basin and Adjacent Channel (FY2012)

The downstream settling basin would be dredged in FY 2012 using clamshell equipment to load the dredged materials onto a bottom-dump barge to dispose at the PSDDA open water site. Clamshell dredges have a hinged bucket of steel with a "clamshell" shape that is suspended from a crane mounted on a barge. During the dredging operations, an anchoring system of wire and anchors or spuds with or without tugs is used to control the position of the barge. The bucket is lowered to the sediment surface with the jaws open. When the force of the bucket weight hits the bottom, the bucket grabs a section of the sediments as the jaws close. The bucket is hoisted

up to the surface with the sediments, which are then placed on a bottom-dump barge for transport to the disposal site. The bottom-dump barge contains the sediment within one large or several smaller compartments and deposits the sediments through doors on the bottom of the barge that open to release the sediments.

The downstream settling basin would be dredged between stations 333+50 to 345+50 to a required depth of -20 feet MLLW with an allowable over-depth of two feet below the required dredge depth (i.e. to -22 feet MLLW). The Corps would also dredge the portion of the navigation channel. The portion of the channel just downstream of the downstream settling basin would be dredged between stations 345+50 to 375+00 to a required depth of –15 feet MLLW with the same allowable over-depth of two feet (i.e. to –17 feet MLLW) (Figure 1). Side slopes along the edge of the dredged portion of the channel would be approximately 1:2 slopes (vertical:horizontal) after dredging. Condition surveys conducted in spring of calendar year 2009 estimated the total volume of sediment available from the downstream settling basin and adjacent reach of the channel was approximately 400,000 cubic yards. Another condition survey will be conducted late in FY2011 for FY2012 dredging. Such surveys are routinely conducted prior to each dredging cycle to determine not only the total volume of sediments that need to be dredged, but also to identify any shoals that need to be removed from the navigation channel. Because the volume of dredged sediment is determined based on annual condition surveys conducted prior to the dredging, it is not possible to exactly predict the volume of material that would need to be dredged. Shoaling rates and depths depend on river flows and sedimentation rates that are driven by seasonal rainfall. Total estimated annual volumes dredged would be 500,000 cubic yards from the downstream areas.

Because only developed shoals would be dredged within the settling basin, dredging will not be needed out to the outer edge of the settling basin based on the shoals indicated on the condition survey. The existing intertidal areas would not be impacted by the proposed dredging. The existing intertidal areas along the edges of the navigation channel would remain, providing a movement corridor for fish and wildlife as the dredging operation proceeds through the basin and down the channel. The approximately 400-foot wide existing intertidal area would be retained along both banks of the navigation channel during and after dredging. This area extends between the outer edge of the dredged channel and Jetty Island to the west of the navigation channel and between the more developed shorelines of the Everett Marina, the 12th Street Channel, and the Everett Naval Station on to the east of the outer edge of the navigation channel. Similarly, the approximately 100 feet of existing intertidal area along the outer-most (western) edge of the widest portion of the downstream settling basin would remain, and the approximately 200 feet of existing intertidal area along the outermost (western) edge of the narrowing portion of the downstream settling basin would also remain. Similarly, the approximately 200 feet of existing intertidal area would remain along the entire eastern edge of the downstream settling basin.

3.1.2 Dredging of Upstream Settling Basin and Adjacent Channel (FY2013)

The upstream settling basin and a portion of the navigation channel just upstream of the upstream basin would be dredged in FY 2013. These areas would be dredged by hydraulic pipeline dredge that allows for direct placement of the dredged material onto the Riverside Business Park or Parcel O sites. Clamshell dredging would be used to remove any available

sediment not needed at the Riverside or Parcel O sites and place it on a bottom-dump barge for transport to the PSDDA open water disposal site.

The upstream settling basin would be dredged between stations 68+00 and 88+00 to an authorized depth of up to –40 feet MLLW, with an allowable over-depth of two feet below the required dredge depth (i.e. to –42 feet MLLW) (Figure 1). This area encompasses approximately 3,500 linear feet of channel (Figure 1). The portion of the channel just upstream of the upstream settling basin would also be dredged between stations 53+00 to 68+00 to a required depth of –8 feet MLLW, with an allowable over-depth of two feet below the required dredge depth (i.e. to –10 feet MLLW). Side slopes along the left bank edge of the dredged channel would be approximately 1:3 slopes (vertical:horizontal) after dredging; side slopes along the right bank edge would be approximately 1:6 (vertical:horizontal) after dredging. Because the volume of dredged sediment is determined based on annual condition surveys conducted prior to the dredging, it is not possible to exactly predict the volume of material that would need to be dredged. Shoaling rates and depths depend on river flows and sedimentation rates that are driven by seasonal rainfall. However, total estimated volumes dredged would be 200,000 cubic yards from the upstream settling basin, and 50,000 cubic yards from the upstream navigation channel.

Because only developed shoals would be dredged within the settling basin, dredging will not occur to the extreme outer edge of the basin based on the shoals indicated on the condition survey. The existing intertidal area with variable widths between 50 and 150 feet wide would remain along both banks of the upstream settling basin and navigation channel in this area during and after dredging. This area extends between the outer edge of the dredged channel and the shoreline of the Parcel O property to the west and the shoreline of the Everett Sewage Treatment facilities to the east of the outer edge of the navigation channel and settling basin.

Preferential disposal options would be beneficial use over open water disposal. Hydraulic dredging would be used if beneficial use sites at previously utilized upland rehandling sites such as the Riverside or the Parcel O site (Figure 3) are available and the shoaled sediments are of appropriate size and quality. Hydraulic dredging would be used to directly place dredged sediments from either the upstream settling basin onto these beneficial use rehandling sites. If using the PSDDA open water disposal site, sediment would be dredged using clamshell equipment and the material transported to PSDDA open water disposal site in Port Gardner Bay.

3.2 DISPOSAL

Open-water disposal activities will be conducted in accordance with established criteria for the PSDDA. Effects of the disposal actions at the PSDDA site are analyzed in the Biological Assessment previously prepared by the Corps, and have been accepted by NMFS and USFWS as described in their respective concurrence letters, and a Biological Opinion (BiOp) from NMFS in December 2010 (USACE 2005, USACE 2007a and 2007b, USACE 2010; USFWS 2005, USFWS 2011; NMFS 2005a, NMFS 2007c, NMFS 2010).

In FY2012, and in all even-numbered years, sediments from the downstream settling basin and adjacent portion of the channel would likely be clamshell dredged and disposed of at the PSDDA open water site. Similarly, in FY2013, and in all odd-numbered years, sediments from the upstream settling basin and adjacent portion of the channel would likely be hydraulically

dredged for use at Riverside Business Park Disposal Areas, or Parcel O site, or clamshell dredged and disposed of at the PSDDA open water site.

3.2.1 PSDDA Open Water Disposal

Any sediment dredged from either the downstream or upstream settling basins or channel that are not beneficially used at Jetty Island or the upland sites would be transported to the PSDDA open water disposal site in Port Gardner and disposed of by bottom-dump barge.

The Corps Dredged Material Management Office requires sampling and testing of sediments from the proposed dredging areas at a frequency determined by the PSDDA guidelines. When sampling is required, the dredged material is tested to determine whether the sediment meets the standards for disposal at the PSDDA site, as well as the Washington State Department of Ecology's Sediment Management Standards (SMS) for in-water beneficial use.

Both the downstream and upstream settling basins and adjacent portions of the navigation channel are considered 'low-moderate' ranked areas for contaminants. When the downstream material was previously tested in accordance with PSDDA protocols in September 2003, the Dredged Material Management Program (DMMP) agencies concluded that the material was suitable for placement at the Port Gardner Bay PSDDA open water disposal site thru September 2010. Similarly, the upstream material was sampled in March 2004 and was found suitable for open-water disposal through March 2011. Sediment testing will be conducted again in FY2011 to determine suitability for open-water disposal for the next five to seven years.

For areas that are frequently dredged, including both the upstream and downstream portions of the federal navigation project, the DMMP frequency guidelines come into play. The frequency guidelines determine how often sampling and testing need to occur. In the case of a low-moderate ranked area, such as the federal navigation project, the frequency guidelines provide a period of 5 to 7 years. Given the plethora of previous testing data from the Snohomish project and the low-risk associated with this sediment, the DMMP agencies agreed to apply a 7-year frequency period to this project. The 7-year frequency period extends to September 2018 for the downstream material and March 2017 for the upstream material. However, because of increased awareness regarding dioxin in recent years and the fact that the Snohomish material had not previously been tested for dioxin, the DMMP agencies required dioxin testing prior to the next cycle of dredging. The dioxin testing was conducted in July 2009. Preliminary test results show that the sediment tested well within the acceptable levels for open-water disposal and beneficial use.

3.2.2 Jetty Island

Occasionally Jetty Island is used as a beneficial use upland disposal site to renourish the soils on Jetty Island (see Section 2.2 for a description of past use). A berm created to enclose a lagoon in 1989 erodes over time and requires renourishment to continue to protect the lagoon. In addition, dredged material is sometimes used at other locations on the island. The most recent disposal on Jetty Island occurred in FY2007. Section 7 consultation was conducted in 2000, and again in 2006, specifically for disposal on Jetty Island (Pentec, 2000; Pentec, 2006). These consultations concluded that disposal at Jetty Island is not likely to adversely affect Chinook salmon, bull

trout, or marbled murrelet, or their designated critical habitat, and will have no effect on killer whale and Steller sea lion and their designated critical habitats; disposal at Jetty Island was also determined to have no effect on humpback whale and leatherback sea turtle. As the BE was prepared prior to listing of steelhead, the determination was that the proposed action was not likely to jeopardize the continued existence of steelhead. The Corps proposed to conduct noise studies to evaluate the potential for effects to migrating steelhead that might occur from the operation of dredging equipment. NMFS concurred with this evaluation.

3.2.3 Riverside Business Park Site

Sediment hydraulically dredged from the upstream settling basin and adjacent portion of the channel would be directly placed onto the 8-acre southern portion of the Riverside Business park site. The sediments would subsequently be 'rehandled' (collected and moved by truck) by the Port for use at the Riverside site or at other regional sites in need of fill material. Up to approximately 250,000 cubic yards of upstream basin sediment would be placed on the Riverside site when the upstream settling basin and adjacent navigation channel would be dredged. Sediment would be transferred to the site through the hydraulic pipeline which extends from the upper settling basin along the left bank river channel and then up and over the existing salt marsh and riparian berm and onto the Riverside site. During past sediment placements at the Riverside site in January 2005, the 22-inch diameter plastic pipeline was towed to the site during high tide. Extra flotation on the pipe at high tide allows the contractor to get the pipe near the landing where a strap around the pipe is attached to a cable that is pulled by a dozer (to snake the pipeline) into the disposal area. The pipeline is pulled up onto and over the intertidal marsh bench by the equipment parked on the upland berm. Location and placement of the pipeline would be conducted in a manner similar to the previously permitted sediment placement at the Riverside site. Great care would be taken during placement of the pipeline to minimize impacts to existing intertidal salt marsh and riparian vegetation along the shoreline to the greatest extent feasible. The salt marsh plants will be in winter dormancy during the approximately three to four week time period when the pipeline will be resting on the marsh and the pipeline does not move once in place. Due to these factors, there are not expected to be any long-term impacts to the limited area of intertidal marsh affected by the temporary placement of the pipeline.

The dredged material 'cell' is separated from the riparian edge of the river by man-made berms of sand to contain the water/sediment slurry. The cell is completely devoid of vegetation and slopes gradually downward to the north to slowly move the water toward the return point as the sediment settles out. Once the sediment settles out of the water/sediment slurry, the water would be returned to the river through a system of metal weirs extending from the end of the dredged material cell through a previously disturbed portion of the riparian edge to the river channel.

Water quality monitoring of the return water by the Corps would ensure State water quality conditions are met within the appropriate mixing zone from point of water discharge. Within the mixing zone, dissolved oxygen cannot drop below 6.0 mg/liter.

3.2.4 Parcel O site

Sediment hydraulically dredged from the upstream settling basin and adjacent portion of the channel would be directly placed onto the 9-acre southeastern corner of the Parcel O (formerly known as Kimberly Clark log yard) site. The sediments would subsequently be 'rehandled' (collected and moved by truck) by the Port for use at other regional sites in need of fill material. Up to approximately 100,000 cubic yards of upstream basin sediment would be placed on the Parcel O site when the upstream settling basin and adjacent navigation channel would be dredged. The method of placement would be conducted in a manner similar to the sediment placement at Riverside Business Park site (refer to description in Section 3.2.2).

3.3 CONSERVATION MEASURES

Certain measures incorporated into the proposed action, including the dredging scheduling, are intended to reduce adverse environmental effects. The measures include:

- The proposed dredging would be conducted between October 16 and February 14. Dredging would thus be avoided during peak juvenile salmon migration months between February 15 and July 15. This would also avoid impacts to juvenile salmonids. Avoiding dredging during peak salmonid out-migration periods would also minimize the short-term effects of the proposed action on the variety of species that prey upon juvenile salmonids.

The principal water quality impact of dredging is the temporary increase in concentration of suspended solids in waters near the dredging site. The effects of dredging on water quality can occur during dredging, during transfer of the dredged material to the barge, or during decant water discharge or if the barge overflows. The proposed dredging would be accomplished using both a clamshell dredge and a hydraulic pipeline dredge. Sediments may be resuspended into the water column through lowering of the clamshell bucket, impacting the bottom with the bucket, closing the bucket, raising the bucket through the water column, and depositing sediments onto the haul barge. A very small amount of suspended sediment would also be generated by the cutterhead of the hydraulic dredge; however, since the dredge is buried in soft, unconsolidated materials (mainly sands), and then suctioned into the large hose, the amount of suspended material is discountable.

These effects are temporary and localized to the immediate area surrounding the dredging. Due to the timing of the proposed dredging operation, they are limited in time to periods outside the migration period for juvenile salmonids and are limited in space to the immediate vicinity of dredging activities. Temporary effects on water quality and on juvenile salmonids would also be minimized by measures (as detailed below):

- Hydraulic dredging will be carried out in a manner that minimizes entrainment of fish and disturbance of the sediment surface outside of the immediate vicinity of the dredging operations. Impacts from the placement of dredged materials on the Riverside Business Park site or at any of the other upland sites would be minimized through directed discharge points and sampling of the return water for total suspended solids and dissolved oxygen.

- Barges used to transport the dredged material to the disposal or transfer sites will not be filled beyond their capacity to completely contain the dredged material in order to minimize spillage of dredged sediments over the side of the barge.
- Disposal operations and material effects will be in conformance with PSDDA management standards.
- To minimize effects to migrating adult steelhead, the Corps will endeavor to dredge as early in the October 16-February 14 work window as possible (October/November) (though dredging may still be required through mid-February).

4 SPECIES AND HABITAT INFORMATION

This section describes the listed species considered in this BE and the habitat indicators important for their survival and recovery. Estuarine habitats are emphasized, because of the potential effects of the proposed dredging and disposal actions on those types of habitats within the Snohomish River navigation channel, which is considered to be an estuary. This evaluation is loosely based on the types of guidelines developed by NMFS to facilitate and standardize the determination of effects of projects/actions on listed anadromous salmonids (i.e. the NMFS Matrix of Pathways and Indicators 1996, the NMFS concepts for salmon habitat in streams 1999b). However, as these tools were developed for freshwater environments, they are not directly applicable to estuarine waters.

Therefore, the following discussion is organized around a set of modified indicator-based categories of habitat function developed from review of scientific literature and best professional judgment. This evaluation is thus generally qualitative in nature and is divided into three main pathways that address water quality, physical habitat quality, and biologic habitat quality. These indicator categories form the matrix of pathways that were used to establish the baseline condition in the project area and to then determine the potential effects of the proposed dredging and disposal actions on these baseline conditions (see Section 5.0).

4.1 Listed Species

Based on species lists provided on the USFWS and the NMFS websites, the species under the jurisdiction of USFWS and NMFS addressed in this BE are listed in Table 1.

Table 1: Species Listed Under the Endangered Species Act found in the Vicinity of the Lower Snohomish River

Common Name	Scientific Name	Federal Listing Status	Has Critical Habitat Been Designated?
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened – October 1, 1992	Yes, designated on May 24, 1996
Steller Sea Lion	*Eumetopias jubatus*	Threatened – November 26, 1990	Yes, designated on August 27, 1993 (not in action area)

Puget Sound/Coastal Bull Trout	*Salvelinus confluentus*	Threatened – November 1, 1999	Yes, designated on September 26, 2005
Puget Sound Chinook salmon	*Oncorhynchus tshawytscha*	Threatened – March 24, 1999	Yes, designated on September 2, 2005
Puget Sound Steelhead	*Oncorhynchus mykiss*	Threatened – May 11, 2007	No
Bocaccio	*Sebastes paucispinis*	Endangered—April 28, 2010	No
Canary rockfish	*Sebastes pinniger*	Threatened— April 28, 2010	No
Yelloweye rockfish	*Sebastes ruberrimus*	Threatened— April 28, 2010	No
Southern Resident Killer Whale	*Orcinus orca*	Endangered-November 15, 2005	Yes, designated on November 29, 2006

Other Federally listed threatened or endangered species that may occur in Puget Sound include humpback whale (*Megaptera novaeangliae*; endangered) and leatherback sea turtle (*Dermochelys coriacea*; endangered). However, these species are extremely unlikely to occur within the lower Snohomish River, Port Gardner Bay, or Jetty Island (i.e. within the action area as defined in Section 1.3) based on extremely infrequent historic occurrences and a lack of typically utilized and appropriate habitat within the action area. These two species are therefore not specifically evaluated in this BE as the proposed dredging and disposal activities would have no effect on these two species. The bald eagle was delisted in 2007. The bald eagle remains protected under the Bald Eagle and Golden Eagle Protection Act (BEGEPA), and is therefore briefly addressed in this BE. The species in the table are addressed in Sections 5 and 6.

4.2 Existing Environmental Conditions

The discussion below presents a synopsis of baseline indicators relevant to an analysis of effects from maintenance dredging and disposal operations. Because these indicators (water quality, physical habitat quality, and biological habitat quality) can directly affect fish populations (such as Puget Sound Chinook salmon, steelhead, and bull trout), they can also affect higher order consumers that feed on fish, such as bald eagles, marbled murrelets, and killer whales.

4.2.1 Water Quality

Much of the water quality data was gathered from the WDOE water quality-monitoring gauge located at river mile 12.7 of the Snohomish River as it flows through the town of Snohomish at the bridge over the river on Avenue D (gauge #07A090). The Snohomish gauge is the closest gauge to the settling basins on the river and is located approximately 6.4 miles above the upstream settling basin.

Water contamination

Ecology is responsible for setting water quality standards for surface waters of the State based on designated water uses and criteria. The waters of the lower Snohomish River from the southern tip of Ebey Island at river mile 8.1 to the mouth have an 'aquatic life use' designation of "salmon and trout spawning, rearing and migration" (WAC 173-201A-600, 602). This area encompasses the navigation channel, and both upper and downstream settling basins. The marine waters of Everett Harbor are designated as "good quality for salmon migration and rearing" (WAC 173-201A-610, 612).

The only portions of the lower Snohomish River on the Department of Ecology's 303(d) list of threatened and impaired waters are within the vicinity of the Riverside Business Park site (Figure 2). Listed parameters in this area include a multitude of chemical contaminants and temperature. Pollutants within the Snohomish River are derived primarily from industrial point and non-point sources, storm water runoff from agricultural fields, and leakage of septic fields. The cities of Everett, Marysville, and Lake Stevens discharge wastewater effluent into the estuary (Snohomish River Basin Salmonid Recovery Technical Committee 2002). The enforcement of total maximum daily load limitations for a number of parameters is expected to result in additional improvements in water quality.

Turbidity and River Flow

The highest sources of turbidity within the navigation channel and the settling basins are periodic pulses of sediment moving downstream within the Snohomish River from seasonal rainfall events and the natural mixing of fine-grained sediments suspended during the tidal cycle. Temporary pulses can also result from prop-wash within the marina and Everett Naval Station.

The water quality sampling gauge data (gauge # 07A090) indicates that the Snohomish River has variable suspended sediment levels within the proposed dredging period, reaching maximum levels in conjunction with maximum flows resulting from winter rainstorms. Average river flow within the time period of the proposed dredging (October 16 through February 14) has been 11,554 cubic feet per second (cfs), with maximum flows of 41,800 cfs, recorded on October 17, 1988. Suspended sediment levels generally reach their maximum between November and January, with pulses of high turbidity during February and early March storms (see below).

Average turbidity levels recorded during the window of the proposed dredging (October 1 through February 14) have been 9.1 NTU, including the highest readings of 110 NTU during the high flows of November 18, 2003, 60 NTU on November 13, 2006, 51 NTU on October 17, 1988, 31 NTU on November 28, 1977, and 27 NTU recorded on December 13, 1982. Lowest readings during the proposed dredging period have been 1 NTU, recorded five times during the month of October (1976, 1980, 1986, 1987, and 1992) and once in November (1976). Higher turbidity levels would be expected downstream of the monitoring station within the mixed waters of the estuary.

The Snohomish River is also characterized by sporadically high levels of suspended sediment occurring just after the end of the proposed dredging window (post February 14). Maximum turbidity levels recorded since 1976 include 100 NTU recorded on February 16, 1982, 90 NTU on February 20, 1995, and 86 NTU recorded on February 17, 1981.

Dissolved Oxygen

The water quality sampling gauge data (gauge # 07A090) indicates that the Snohomish River has generally high dissolved oxygen levels within the proposed dredging period, reaching maximum levels generally between mid-December and mid-February. Average dissolved oxygen levels recorded during the window of the proposed dredging (October 1 through February 14) have been 12.0 mg/L, including the highest readings of 13.5 mg/L on December 10, 1990, 13.3 mg/L on December 12, 2001, January 18, 1993, and January 23, 1984. Lowest readings during the proposed dredging period have been 9.6 mg/L, recorded on October 19, 1987. Dissolved oxygen levels between 9.0 and 10.0 mg/L have been recorded more commonly between July and September, corresponding with the lowest annual stream flows. The lowest recorded dissolved oxygen level (8.1 mg/L) was recorded on August 15, 1977.

Temperature

The water quality sampling gauge data (gauge # 07A090) indicates that the Snohomish River has fluctuating, but generally low water temperatures within the proposed dredging period. Average temperature recorded during the window of the proposed dredging (October 1 through February 14) was 6.3°C. The highest temperatures during the proposed dredging period have generally occurred in mid-October, with high temperatures of 14.1°C on October 6, 1980, 11.8°C on October 19, 1993, 11.7°C on October 18, 2005, and 11.5°C on October 16, 2006. Lowest readings during the proposed dredging period have been 0.1°C, recorded on January 28, 1980. Temperatures greater than 17.5°C (lethal to developing fish embryos) have generally been recorded only during July –August. The highest recorded temperature (21.6°C) was recorded on August 15, 1977 (on the same date as the lowest recorded dissolved oxygen levels).

4.2.2 Physical Habitat Quality

Sediment contamination

Testing of sediment from the downstream settling basin and adjacent channels was conducted in 2003 and resulted in no exceedances of the DMMP screening levels. On this basis the material was found suitable for disposal at the Port Gardner open-water site. Likewise, testing of the upstream settling basin in 2004 indicated that there were no screening level exceedances. In addition, there were no detected exceedances of the State of Washington Sediment Quality Standards for either the downstream or upstream material, and the DMMP agencies found all material suitable for beneficial use such as Jetty Island.

Thus, despite industrial pollution within the lower Snohomish River, previous rounds of DMMP sediment characterization have determined that sediments from the downstream and upstream settling basins and the navigation channel have been suitable for both beneficial use and PSDDA open water disposal.

In 2009, because the Snohomish material had not previously been tested for dioxin, the DMMP agencies required dioxin testing prior to FY2010 dredging. The dioxin testing was conducted in July 2009. Final suitability determination test results show that the sediment tested well within the acceptable levels for open-water disposal and beneficial use (USACE 2009). Testing for dioxin does not need to be repeated.

Shoreline and Estuarine Habitat Conditions

Much of the eastern shoreline of Port Gardner Bay (as well as the adjacent shorelines of Puget Sound) is almost exclusively armored (rip rapped). The existing shoreline banks are thin bands of mud- and sand-flats along the toe of the riprap. Common shoreline features also include constructed bulkheads and piers, principally for large commercial and industrial marine users.

The estuarine shorelines along the lower Snohomish River upstream of Preston Point are armored with riprap and pilings in many locations, but also contain areas with native mud banks. The southern portion of estuary is predominately characterized as fluvial freshwater and was historically a mosaic of tidal marshes, forested wetlands, and intertidal sloughs. Today these areas are predominately diked and in agricultural production, with exceptions on the southern end of Spencer Island (just upstream of the upstream settling basin), on which the dikes have been breached to restore tidal influence, and on Otter Island, which was never diked. The central portion of the estuary, located along either side of I-5 and parallel to the central portion of the navigation channel is characterized as fluvial brackish water and dominated by brackish tidal marshes and diked palustrine marshes. Wide shoreline mudflats are found along Steamboat and Ebey Sloughs and the majority of the eastern islands have broken dikes and are thus again subject to tidal inundation. Estuarine emergent marshes exist north of the navigation channel at the mouths of Ebey and Steamboat Sloughs and Quilceda Creek. Existing areas of estuarine marsh vegetation fringe the lower riverbanks within the vicinity of the Riverside Business Park site and the upstream settling basin, as well as the eastern shore of Jetty Island along the downstream settling basin.

Disturbance/Noise

Due to the developed nature of Port Gardner Bay and the lower Snohomish River, these areas are subject to frequent and intense noise and disturbance associated with the commercial, maritime, and industrial facilities along the shoreline including marine traffic to and from the Everett Marina and the Everett Naval Station. The lower end of the river is subject to recreational vessels of all types and sizes launching and mooring at the Everett Marina. Hand-launch vessels also frequent the lower estuary and sloughs near the upstream settling basin, but generate considerably less disturbance and noise than motorized vessels. Existing noise and disturbance levels are thus typically fairly high within the majority of the action area—according to recent noise studies (Pentec 2010; SAIC 2011), the ambient underwater noise level in the Snohomish River navigation channel ranges from 123-164 dB.

4.2.3 Biological Habitat Quality

Fish and Wildlife

Biota utilizing habitats within the action area (the lower Snohomish River) include a variety of marine and aquatic invertebrates, estuarine and marine fish and shellfish, anadromous salmonids, birds, and marine mammals.

The Snohomish River and its estuary support runs of seven salmonid species: Chinook (*Oncorhynchus tshawytscha*), coho (*O. kisutch*), chum (*O. keta*), and pink salmon (*O. gorbuscha*), as well as steelhead (*O. mykiss*), sea-run cutthroat trout (*O. clarki*), and native char -

dolly varden (*Salvelinus malma*), and bull trout (*S. confluentus*). All of these species spawn in freshwater upstream of the estuary, and adult use of the estuary (and therefore of the proposed dredging areas) is largely limited to a migration corridor and as a physiological transition area from salt to fresh water. In contrast, juvenile salmonids depend on estuarine environments for migration, physiological transition from fresh to salt water, feeding, and refuge from predation during migration. There is considerable variation by species in juvenile residence periods in the estuary, with coho, chum, and Chinook juveniles being relatively more dependent on the estuarine environment than pink, steelhead, sea-run cutthroat, and native char, which quickly move through the estuary to marine waters.

Benthic and Epibenthic Prey Availability

Benthic and epibenthic invertebrate prey assemblages associated with the intertidal habitats created in and around Jetty Island have been documented by Pentec as part of their post-construction monitoring of the island. Their studies have documented rapid colonization and high epibenthic zooplankton productivity in the mudflats within the protected embayment formed by the berm (Pentec 1996). Since 1990, qualitative excavations have shown a continual increase in the apparent density and diversity of the infaunal community, including polychaetes, crustaceans, and mollusks. The density and diversity of invertebrate assemblages within and around Jetty Island, as well as within the larger Snohomish River estuary is also evidenced by the migratory and year-round use of the area by foraging shorebirds.

Pentec Environmental has documented invertebrate species assemblages within the lower Snohomish River (mainly downstream of the upstream settling basin) as part of their work for the Port of Everett (1992). Common invertebrates (which are typically preyed upon by salmonids) include: snails (*Littorina spp.*), polychaetes (*Nereis spp, Notomastus spp., Nephtys spp. Glyceria spp.*), shore crabs (*Hemigrapsus spp.*), isopods (*Gnorimosphaeroma oregonensis*), ghost shrimp (*Callianassa spp.*), Dungeness crab (*Cancer magister*), and red crab (*Cancer productus*). Juvenile salmonids also prey preferentially on certain species of tiny crustaceans including amphipods (e.g., Co*rophium spp., Anisogammarus, Eogammarus*), some species of harpacticoid copepods (e.g., *Harpacticus uniremis, Tisbe sp.*), cumaceans, opossum shrimp, and midges (Chironomid larvae) which are also common in the intertidal mudflats and marshes of the lower estuary.

While the intertidal habitats of the lower Snohomish River have been studied and documented over the past five years, benthic assemblages within the deeper and unvegetated portions of the settling basins and dredged portions of the navigation channel are not well documented, although are expected to be of much lower biodiversity than those of the adjacent intertidal marshes and mudflats due to their depth and regular accumulation of fine sediments, as well as recurring disturbance by dredging. Because of their occurrence at deeper depths, the assemblages within the center of the basins and navigation channel are also likely of lower functional value to juvenile salmonids.

Forage Fish Availability

Forage fish larvae are ubiquitous in Puget Sound and are a common component of the nearshore plankton. As such, it is difficult to determine the source of this prey item within any given

estuary. Very little research has been done to determine if larvae using any given estuary originate in nearby spawning grounds. Intertidal spawning habitat was historically more abundant, however, armoring and other shoreline modifications have limited the amount of available spawning areas.

Forage fish include Pacific herring, surf smelt, and sand lance larvae and juveniles prey on epibenthic invertebrates and are themselves important prey items for larger juvenile salmon and bull trout. Sand lance is particularly important for juvenile Chinook and bull trout. Both juvenile surf smelt and sand lance have been captured by Pentec during seining within the lagoon formed by the berm on Jetty Island (Pentec 1996) and are abundant in the shallow waters of the Snohomish River estuary and the nearshore marine waters of Possession Sound and Port Gardner Bay. None of these forage fish species spawn at the open water disposal sites or within the lower Snohomish River due to the modified shoreline and lack of intertidal gravel and sandy beaches (WDFW 2008).

Within the action area, surf smelt spawning occurs on beaches to the south of the Everett Naval Station along the Mukilteo shoreline, along the southern shore of Whidbey Island and Port Susan, and along the southeastern shore of Whidbey Island (WDFW 2008, D. Pentilla Washington State Surf Smelt Fact Sheet undated). Documented Pacific sand lance spawning beaches occur in these same areas, as well as use of the Gedney Island shoreline (WDFW 2008, D. Pentilla, Washington State Sand Lance Fact Sheet, undated). Pacific herring spawn along the shoreline northwest of the Tulalip Indian Reservation and along the eastern shore of Camano Island (WDFW 2008, D. Pentilla Washington State Pacific Herring Fact Sheet undated).

Birds

Bald eagles are occasionally seen flying over the Port Gardner Bay PSDDA site. Bald eagles are commonly seen flying over Possession Sound and are frequently seen perching and foraging along the lower Snohomish River. A bald eagle nest occurs within approximately one mile of the downstream settling basin and Jetty Island and within approximately two miles of the upstream settling basin, the Riverside Business Park site, and the Parcel O site (WDFW 2008).

Similarly, marbled murrelets are a permanent, though not common resident of southern Puget Sound in the vicinity of the open water disposal sites and the lower Snohomish River. In the Pacific Northwest, they forage almost exclusively in the nearshore marine environment (mainly within a few miles of shore), but nest in old growth forests as much as 50 miles from marine waters. Marbled murrelet nests do not occur within the action area, but murrelets may forage within the water of Possession Sound, particularly during the winter.

The Snohomish River estuary is recognized as regionally important during spring migrations of shorebirds and fall migrations of raptors and waterfowl. The abundant waterfowl, marine birds, and shorebirds within the lower Snohomish River provide an avian prey base for bald eagles, peregrine falcons, merlins, and other raptors. Common species include ring-necked ducks, American wigeons, Canada geese, mallards, pintail, scoters, mergansers, and bufflehead. Other common species include double-crested cormorants, western grebes, American coots, brant, pigeon guillemots, and several gull species (Pentec 1992). During winter migrations, the flooded agricultural fields along the lower Snohomish River attract snow geese, trumpeter swans, snowy owls, merlins, great-horned owls, and gyrfalcons. Shorebirds are commonly observed along the

lower river in the tidal mudflats and marshes or along sandy shorelines. Common species include dunlins, western sandpipers, dowitchers, black-bellied plovers, and yellowlegs (City of Everett et al. 1997). Eighteen species of shorebirds have been observed and over 8,700 individuals were reported on April 27, 1995 using the habitats on the Jetty Island berm (Pentec 1996).

Several other bird species that inhabit the action area are either Federal Species of Concern or are listed by Washington State as Monitor, Candidate, or Sensitive species. The peregrine falcon (Federal Species of Concern and State Sensitive), osprey (State Monitor), great blue heron (State Monitor), and purple martin (State Candidate) all occur within the action area and have been observed either near the open water disposal sites or along the lower Snohomish River.

A pair of peregrine falcons is reported to be nesting on the SR 529/Highway 10 bridge over the Snohomish River, approximately 2 miles upstream of the downstream settling basin and 2 miles downstream of the upstream settling basin (WDFW 2008). Peregrine falcons likely hunt waterfowl over the disposal sites in Possession Sound, and within the vicinity of the settling basins in Port Gardner Bay. Peregrine falcons likely hunt shorebirds, waterfowl, and pigeons over the lower Snohomish River and associated shoreline industrial and marine facilities.

Osprey are frequently seen foraging for fish over Possession Sound, Port Gardner Bay, and the lower Snohomish River and appear to be fairly tolerant of human disturbance when choosing nesting locations. Approximately 20 osprey nests have been documented over the last decade within a mile of the downstream settling basin in Port Gardner Bay (WDFW 2008). Many of these nests remain active.

Similarly, great blue herons are frequently seen wading within the intertidal areas of the lower Snohomish River. Bald eagles are known to disrupt rookeries while attempting to prey upon young herons. There is an active heron rookery documented approximately 1.5 miles northeast of the upstream settling basin on Spencer Island. Other nesting activities documented within the area include a rookery northwest of the downstream settling basin at Priest Point and a nest at the south end of Lake Stevens (WDFW 2008).

The horned grebe and red-necked grebe (State Monitor species), as well as the western grebe, Brandt's cormorant, merlin, and common murre (all of which are State Candidate species) and the common loon (State Sensitive species) are likely to forage over or use surface waters associated with the PSDDA open water disposal site in Port Gardner Bay. Jetty Island provides feeding and refuge areas for large numbers of migrating and overwintering shorebirds. These in turn attract avian predators such as peregrine falcons. Bald eagles and northern harriers frequently utilize Jetty Island for feeding. The island also provides habitat for migrating songbirds.

5 EFFECTS OF THE ACTION

The effects of disposal of the dredged material at the PSDDA open water disposal sites have been analyzed in detail in previous BE and amendments (USACE 2005, USACE 2007a and 2007b). Both USFWS and NMFS have concurred with the effects determinations presented in those documents for potential effects from proposed disposal activities at the PSDDA (USFWS 2005, NMFS 2005a, NMFS 2007c). The latest PSDDA consultation is based on a BE written in

August 2010, and concluded with receipt of a biological opinion (BiOp) from NMFS dated December 22, 2010, and a concurrence letter from USFWS dated January 11, 2011 (USACE 2010; USFWS 2011; NMFS 2010).

Consequently, this analysis focuses primarily on the short- and long-term, direct and indirect effects of routine maintenance dredging of the lower and upstream settling basins and adjacent portions of the navigation channel on Federally listed or proposed endangered or threatened species under the jurisdiction of USFWS and NMFS. This BE therefore covers proposed maintenance dredging and upland disposal actions that will begin in Fiscal Year 2012, and occur between October 16 and February 14 of each year.

Effect determinations were based on predicting changes from the baseline condition of the indicator-based categories of habitat function described in Sections 3 and 4. This evaluation is generally qualitative in nature and is divided into effects on the water quality, physical habitat quality, and biologic habitat quality pathways (Sections 5.1, 5.2, and 5.3), followed by a synopsis of potential interrelated, interdependent, and cumulative effects. Species-specific effect determinations (Section 6.0) conclude this document.

5.1 Effects on Water Quality

5.1.1 Water contamination

Ecology regulates water quality through a project specific Water Quality Certification and short-term Modification to the Water Quality Standards authorizations, if necessary to accommodate 'essential' activities. The Corps has been actively coordinating with Ecology to obtain a Clean Water Act Section 401 Water Quality Certificate for this project, including a temporary water quality modification and associated points of compliance, as well as water quality monitoring during dredging and upland disposal activities.

In case water quality parameters exceed established maximum standards, typical corrective measures include: (1) modifying the dredging activity or equipment; (2) reducing the dredging rate; or (3) stopping dredging operations. These corrective measures would apply until dredging operations demonstrated compliance with water quality standards. Compliance with Ecology's Water Quality Certification standards is expected to minimize water quality impacts during dredging to levels that will not degrade water quality conditions within the action area.

Because of the testing regime and permitting conditions described above, no contamination of the water column as a result of the dredging or subsequent disposal is expected. Disposal activities will be conducted in accordance with established criteria for the sites.

Therefore, temporary impacts to water quality chemistry during dredging are expected to be insignificant and discountable and are not expected to significantly degrade the existing water quality condition through water contamination within the action area or have adverse effects on listed species (as detailed in Section 6.0).

5.1.2 Turbidity

Temporary increases in suspended sediment concentration are expected in the dredging areas where clamshell dredging will be conducted. During clamshell dredging (FY2012 and even-numbered FYs), suspended sediment concentrations vary throughout the water column, with larger sediment plumes typically occurring at the bottom closer to the contact point of the clamshell. Concentrations typically then decrease exponentially moving away from the dredging site both vertically and horizontally. LaSalle reported an affected plume area of 300 meters at the surface and 450 meters at the bottom for bucket dredging in San Francisco Bay (LaSalle 1990). LaSalle also reports that suspended sediment concentrations in surface and bottom waters can be highest for bucket dredges (compared to hydraulic cutterhead, hopper, and agitation dredging) due to: 1) sediment suspension from the bucket's impact on the bottom and the withdrawal of the bucket from the bottom, 2) material washing from the top and sides of the bucket as it passes through the water column, 3) spillage as the bucket breaks the water's surface, 4) spillage of material during barge loading, or 5) intentional overflow in an attempt to increase the barge's effective load (LaSalle 1990).

For hydraulic dredging (in FY2013 and odd-numbered years, as well as some even-numbered years when beneficial disposal at Jetty Island is deemed necessary), turbidity is expected to be at very low levels, if at all visible. This is due to the nature of the vacuum action of hydraulic dredging, wherein virtually all sediments and suspended sediments within close range of the cutter head will be drawn into the dredge. Some suspended sediments will likely escape the dredge, but the extent and duration of their suspension will be far less than that resulting from clamshell dredging.

These increases in turbidity could affect juvenile salmonids occurring in the immediate dredging area through decreased visibility for behaviors such as feeding and homing, territoriality, and avoidance responses, as well as direct impairment of oxygen exchange due to clogged or lacerated gills. Duration, timing, and particle size and shape have been shown to influence the potential affect of increased turbidity on Pacific salmon juveniles, but there is little specific information on thresholds of physical, physiological, or behavioral tolerances for particular species. It is unknown what threshold of turbidity might exist that serves as a cue to fish to avoid light reducing turbidity. The primary determinate of risk level for a particular species is likely to lie in the spatial and temporal overlap between the area of elevated turbidity, the degree of turbidity elevation, the occurrence of the fish, and the options available to the fish for carrying out the critical function of their particular life-history stage (Nightingale and Simenstad 2001).

The available evidence indicates that total suspended solids (TSS) levels sufficient to cause such effects would be limited in extent during dredging. LeGore and Des Voigne (1973) conducted 96-hour bioassays on juvenile coho salmon using re-suspended Duwamish River sediments. Acute effects were not observed at suspended sediment concentrations up to 5 percent (28,800 mg/l dry weight), well above levels expected to be suspended during dredging. Salo et al. (1979) reported a maximum of only 94 mg/l of sediment in solution in the immediate vicinity of a working dredge in Hood Canal. Palermo et al. (1986) reported that up to 1.2 percent of sediments dredged by clamshell became suspended in the water column.

The proposed dredging period also coincides with periods of naturally higher background turbidity due to high winter levels of precipitation and runoff. Average turbidity levels recorded during the window of the proposed dredging (October 1 through February 14) have been 9.1 NTU, including the highest readings of 110 NTU during the high flows of November 18, 2003, 60 NTU on November 13, 2006, 51 NTU on October 17, 1988, 31 NTU on November 28, 1977, and 27 NTU recorded on December 13, 1982. Lowest readings during the proposed dredging period have been 1 NTU, recorded five times during the month of October (1976, 1980, 1986, 1987, and 1992) and once in November (1976).

temporary increases in turbidity (no more than two or three hours, and not exceeding standards; if standards are exceeded for more than two hours, or over a distance greater than 300 feet downstream from the hydraulic dredge (600 feet downstream from the clamshell dredge), dredging is stopped until the turbidity falls below standards) are expected during active dredging of the settling basins and the channel (whether by clamshell or hydraulic pipeline dredge). Temporary increases (for just a few minutes (see USACE 2009a) in turbidity are expected during release of the sediments from the bottom-dump barges and upon contact of the dredged sediments with the sea floor at the PSDDA open water site. During dredging and disposal, suspended sediment concentrations vary throughout the water column, with the highest degree of suspended sediment typically occurring at the point of contact of the dredge with the sediment, and at the release point of the barge. Concentrations typically decrease exponentially moving away from the dredging site both vertically within the water column and horizontally across the bottom, and decrease with the movement of the river current and tides. Areas of increased turbidity over background levels are expected to last only for a short duration (no more than a few hours) during the dredging operations.

Increases in turbidity over background levels could affect juvenile salmonids in the immediate vicinity of the active dredging operation if dredging were to occur when juveniles were present in the lower river. The primary determinant of risk is likely to lie in the spatial and temporal overlap between the area of elevated turbidity, the degree of turbidity elevation, the occurrence of the fish, and the other habitat options available to the fish for carrying out the critical function of their particular life-history stage (Nightingale and Simenstad 2001). Any early migrating juvenile salmonids or adults that may be transiting through the downstream settling basin could hold in the adjacent intertidal areas along the eastern shoreline of Jetty Island until increased turbidity dissipates to background levels. Similarly, early migrating juveniles or adults transiting through the upstream settling basin or within the vicinity of the Riverside Business Park and Parcel O sites could hold along the shoreline or move up into Union or Steamboat sloughs until the turbidity dissipates.

While turbidity would be elevated for a few hours in the vicinity of the dredge and disposal barge, total suspended sediment levels sufficient to cause adverse effects would be very limited in extent and duration. To reduce potential negative effects of turbidity on juvenile salmonids, even of limited duration, dredging operations would be timed between October 16 and February 14 specifically to avoid juvenile out-migration periods. This timing would dramatically reduce the temporal overlap between anticipated increases in turbidity during dredging and disposal and the presence of juvenile salmonids within the lower Snohomish River. This will consequently reduce the potential for exposure of juveniles to harmful levels of turbidity to a negligible level. In addition, the proposed dredging would occur in the winter when background levels of

turbidity are naturally higher due to precipitation and runoff; this further reduces the proportional effect of any temporary increases in turbidity. Therefore, temporary increases in turbidity during dredging and disposal activities are expected to be insignificant and discountable and are not expected to result in long-term degradation of water quality through increased turbidity within the action area.

5.1.3 Dissolved Oxygen

Dissolved oxygen (DO) concentrations tend to decline in the vicinity of dredging and disposal operations when the suspension of anoxic sediments creates high chemical oxygen demand. Temporary decreases in DO associated with increased suspended sediments have been known to occur in the immediate dredging plume area. Short-term, temporary effects on fish as a result of decreases in DO include avoidance of the dredging area and reduced foraging during and immediately after dredging as fish avoid areas of temporarily depressed dissolved oxygen. Recently updated WDOE Water Quality Standards dictate that minimum dissolved oxygen concentrations not fall below 8.0 mg/L for waters designated as non-core areas for salmon and trout rearing and migration (such as the lower Snohomish River) (WAC Chapter 173-201A, WDOE 2003) without a Modification to Water Quality Standards issued by WDOE. Within the time period of the proposed dredging in the Snohomish River, minimum dissolved oxygen levels were 9.6 mg/L recorded on October 19, 1987, in conjunction with the minimum record flow in the river (850 cfs).

Adult fish are expected to avoid any localized areas of significantly depressed dissolved oxygen and utilize the adjacent, non-dredged areas for refuge during operation of the dredge. Juvenile salmonids will not be exposed to reduced dissolved oxygen conditions due to the timing of dredging between October 16 and February 14, outside of their migratory window. Potential impacts due to reductions in dissolved oxygen levels as a result of dredging/disposal operations are thus expected to be highly localized and temporary.

Therefore, temporary decreases in dissolved oxygen during dredging are expected to be insignificant and discountable and are not expected to result in long-term degradation of the existing water quality condition within the action area or to have adverse effects on listed species (as detailed in Section 6.0).

5.1.4 Temperature

The proposed maintenance dredging is not expected to significantly alter the depth or extent of the salt wedge within the lower Snohomish River. The resulting configuration of the bottom will not significantly change currents or flow pathways within the navigation channel from their historic condition since the authorization of maintenance dredging in 1910 of the navigation channel. Dredging will remove areas of shoaled sediments and will return the settling basins and portions of the navigation channel to their authorized depths. The dredging will similarly have no effect on the distribution or density of riparian vegetation fringing (and shading) the river.

Therefore, the proposed dredging is not expected to result in a change to water temperature in the action area or to affect listed species that may be sensitive to changes in water temperature (as detailed in Section 6.0).

5.2 Effects on Physical Habitat Quality

5.2.1 Sediment Contamination

The testing protocol for sediments within the proposed dredging area ensures that any contaminated sediments are identified prior to dredging. This testing thus minimizes the potential resuspension or transport of contaminated sediments to other areas by preventing contaminated sediments from being disturbed during dredging. Sediments from the proposed dredging areas are considered to be of 'low-moderate' risk for contamination and have been consistently found suitable for both beneficial uses and open water disposal since the first PSDDA sediment characterization in 1993 (see Section 0).

In 2009, because the Snohomish material had not previously been tested for dioxin, the Dredged Material Management Program agencies required dioxin testing prior to FY2010 dredging. The dioxin testing was conducted in July 2009. Final suitability determination test results show that the sediment tested well within the acceptable levels for open-water disposal and beneficial use (USACE 2009). Testing for dioxin does not need to be repeated.

Therefore, the proposed dredging is not expected to change the degree, nature, or distribution of sediment contamination within the action area or to have an adverse effect on listed species (as detailed in Section 6.0).

5.2.2 Shoreline and Estuarine Habitat Conditions

Maintenance dredging will not result in any deepening and/or widening of the navigation channel or the settling basins; dredging will only be conducted to maintain the authorized depths (plus up to 2 feet over-depth) of the navigation channel (-8 feet) and the settling basins (lower basin –15 to –20 feet, upper basin –30 feet). The dredging is unlikely to degrade the migratory pathway or foraging habitat of juvenile salmonids because they generally follow shoreline habitats and would not be expected to utilize the 150-foot wide center of the navigation channel (where the dredging is concentrated), and would also not be expected to be in the dredging area during the window of October 16 to February 14. The dredging would not impact intertidal mudflats or areas of saltmarsh.

Therefore, the proposed dredging is not expected to significantly degrade the character or distribution of shoreline or estuarine habitat or to negatively affect the ability of listed species to utilize those habitats (as detailed in Section 6.0).

5.2.3 Disturbance/Noise

Maintenance dredging within the lower Snohomish River will temporarily increase ambient noise levels as the dredge is working. Lights operating on the dredge will temporarily increase

ambient lighting levels at night in the immediate vicinity of the dredge, but are not expected to adversely affect adjacent habitats due to the short duration of their presence. Noise and activity during dredging operations could temporally flush some species from the adjacent shoreline areas and from the immediate area of the working dredge, but this effect is expected to be temporary. Once the dredge ceases to operate, there will be no long-term effects from the temporary increase in noise.

Noise from the two types of dredges to be employed is somewhat different. The noise from a clamshell dredge is punctuated by its entry into the water, and the closing of the jaws of the clamshell. There are periods of quiet between the events when the clamshell enters the water. In contrast, the hydraulic dredge operates continuously (though is idle for as much as 50% of each day during shift changes), generating an essentially loud hum, perhaps similar to a grinding noise, in the water column, at sound levels between 60-80 dB (Columbia Association, 2007). The dredge is shut down periodically, for example, during shift changes, for repairs, or at the completion of the dredging at a particular location. The only time the noise ceases is when the dredge is shut down for repairs, or at the completion of the dredging work. While migrating fish may be startled by the crash of the clamshell dredge striking the water (at a sound level of between 140-150 dB (Houghton, 2009)), we assume that they will soon realize there is no danger and will resume migrating once the clamshell is lifted from the water. Further, as Houghton points out, criteria for underwater noise established by NMFS and USFWS to minimize effects to salmonids relative to pile driving projects require a peak sound pressure level of no more than 206 dB and an accumulated sound exposure level (SEL) of 187 dB for all fish 2 grams or larger. For fish less than 2 grams, the criterion for accumulated SEL is 183 dB (FHWG 2008).

Regarding airborne noise, this area typically reflects the noise of motor vehicles along Interstate 5 and State Highway 529. Other typical existing noise consists of those generated by the ship traffic in the navigation channel, as well as air traffic from nearby Paine Field. Ambient airborne noise was measured at 72-95 dB re 1 µPa (Pentec Environmental 2010; SAIC 2011).

The Port of Everett conducted a study to measure the noise generated by an operating clamshell dredge in the Snohomish River in 2009 (Pentec Environmental, 2010). The Corps conducted a study to measure the sound of an operating hydraulic dredge in the Snohomish River in 2010 (SAIC, 2011, draft report). Both types of dredges emit noise below the threshold for harassment of anadromous salmonids. Ambient underwater noise in the navigation channel was measured at 123-164 dB (re: 1 micro Pascal, root mean square (1 uPa, rms)) (SAIC and RPS/EH, 2011). Measurements of sound levels generated by dredging were as high as 177 dB 1 uPa, rms for a hydraulic dredge, and 170 dB 1 uPa, rms for a clamshell dredge (Pentec 2010, SAIC and RPS/EH, 2011). However this sound was subsumed into background within 150 meters. In addition, the operating dredge is just one of many vessels that use the navigation channel each year. The sum total of vessels generate considerable underwater noise contributing to ambient sound levels; in the lower Snohomish River noise from the three highways that cross the river also contribute to the underwater ambient noise levels (Pentec, 2010, SAIC and RPS/EH, 2011).

5.3 Effects on Biological Resources

5.3.1 Salmonids

Both clamshell and hydraulic dredge would be used for the proposed project. Due to the characteristics of this equipment, it is generally accepted that clamshell buckets have extremely low potential to entrain mobile organisms because the bucket movements are slow and the bucket is open. Due to this understanding of the operation of the clamshell, no specific studies of entrainment of fish have been conducted on this type of equipment. In contrast, due to the recognized potential for hydraulic dredges to entrain fish, the hydraulic dredge has been studied extensively. Typically, hydraulic dredges have been found to entrain few or no salmonids or other mobile fishes (McGraw and Armstrong 1988, Larson and Moehl 1988, Larson and Cassidy 1990, Kyte and Houghton 1994, Reine et al. 1998). Based on the operation of the clamshell dredge bucket, and the ability of salmonids to avoid entrainment in hydraulic dredges, the proposed dredging using an open clamshell bucket is not likely to entrain juvenile, sub-adult, or adult salmonids.

The temporary increases in noise, turbidity, and water column disturbance during the dredging is expected to signal adult fish to avoid the area during dredging activities. Because intertidal areas are located outside the edges of the dredging areas and because the dredging is generally centered within the navigation channel and settling basins, adults can readily avoid the disturbed portion of the water column by moving toward the shoreline and either holding or transiting around the area being dredged. The proposed dredging is not likely to adversely affect adult salmonids if their upstream migration overlaps the dredging period. Due to the timing of the dredging, few juvenile salmonids are expected to migrating through the waterway or using the adjacent shoreline habitats. If any early migrants are moving through the area during the period of dredging, they are likely to remain near the shoreline, thereby avoiding the disturbances associated with dredging in the main navigation channel.

Therefore, although there will be temporary increases in noise and disturbance, coupled with temporary decreases in water quality surrounding the dredging, these are expected to be insignificant and discountable effects on local fish populations in the action area and are not expected have adverse effects on listed fish species (as detailed in Section 6.0).

5.3.2 Benthic and Epibenthic Prey Availability

Dredging will temporarily reduce the populations of the benthic and epibenthic invertebrate community through removal of the benthic substrate and smothering as suspended sediments settle out of the water column. Invertebrate prey for juvenile salmonids and bottom fish will thus be temporarily reduced within the navigation channel and the settling basins. Total organic carbon could be slightly lower in the newly exposed sediments after dredging. Thus, the amount of food (in the form of organic matter) available for benthic invertebrates immediately adjacent to the edges of the dredged channel and basins would be slightly reduced on a temporary basis.

While benthic and epibenthic prey species will be temporarily displaced, populations are expected to recover shortly (within one year) after dredging activities are completed. Dredging in the Snohomish River tends to occur every other year (while the dredging location shifts generally from upper to lower each year), so the benthic populations are expected to fully recover between dredging cycles. Adjacent undisturbed intertidal habitat along the channel edges will continue to provide an established source of benthic and epibenthic invertebrates to colonize the newly disturbed subtidal substrate. Since new invertebrate communities will recolonize the dredging area, no long-term loss of biological productivity or prey base for juvenile salmonids or bottom fish is expected.

Therefore, although there will be temporary decreases in benthic and epibenthic prey within the dredged area, this decrease is expected to cause an insignificant and discountable effect on local fish populations in the action area and are not expected have adverse effects on listed fish species through food web interactions (as detailed in Section 6.0).

5.3.3 Forage Fish Availability

Temporary effects on the forage fish community are possible during dredging and disposal activities. Forage fish such as Pacific herring and surf smelt are expected to avoid the dredging area, resulting in a temporary loss of forage fish from the immediate area during the dredging period. Sandlance—which may be found in the Snohomish River estuary (Inoue, et al, 1967, *fide* Robards, et al, 1999)—could be entrained in both clamshell buckets and hydraulic dredges.

Dredging and disposal activities are not expected to effect the spawning of Pacific herring, surf smelt, or sand lance because there is no appropriate spawning habitat within the immediate vicinity of the dredging or disposal activities, though individuals of these species may be present in small numbers. Forage fish are expected to immediately return to their usual foraging areas and behaviors after the dredging and disposal activities stop.

Therefore, although there will be temporary disturbance to forage fish populations, coupled with temporary decreases in water quality surrounding the dredging, these are expected to be insignificant and discountable effects on local forage fish populations in the action area and these effects are not expected have adverse effects on listed fish species through food web interactions (as detailed in Section 6.0).

5.3.4 Intertidal Vegetation

Dredging of the lower navigation channel and the downstream settling basin will not affect the extent or condition of intertidal marshes or shoreline vegetation in this area. An approximately 400-foot wide intertidal area would be retained along both banks of the navigation channel upstream of the downstream settling basin.

Dredging of the navigation channel and the upstream settling basin would not affect the extent or condition of intertidal marshes or shoreline vegetation in this area. The intertidal area along both banks of the upstream settling basin and navigation channel varies between 50 and 150 feet wide; this area would be retained during and after dredging. By maintaining the navigable depth of the waterway, the proposed dredging would help prevent vessels from stranding on intertidal

marshes along the navigation channel. Vessel stranding and salvage has the potential to cause long-term disturbance to salt marshes.

Placement of the plastic pipeline is not expected to significantly or permanently damage the intertidal saltmarsh bench. Floating the pipeline into place and then pulling the pipeline across the bench with equipment parked in the upland is expected to minimize disruption to the marsh surface. During past placements, it was not necessary to drive or park track or rubber tire equipment on the marsh. Setting the hydraulic pipeline onto the intertidal salt marsh along the southern end of the Riverside Business Park site would temporarily cover the portion of the marsh beneath the pipeline (approximately 2 feet wide and about 75 feet in length). Because the marsh vegetation would be dormant during the proposed dredging and disposal period (October 16 to February 14) and the pipeline would be in place for sixty to ninety days during that time, the impacts from this temporary placement are not expected to reduce the ability of the salt marsh to resprout in the spring following the dredging activities. Therefore, any changes to the distribution, character, or abundance of subtidal and intertidal vegetation as a result of dredging and disposal activities are expected to be insignificant and discountable and are not expected to result in long-term degradation of these communities within the action area.

The proposed dredging is thus not expected to degrade the character or distribution of intertidal vegetation, or to negatively affect the ability of listed species to utilize intertidal marshes in the vicinity of the proposed dredging (as detailed in Section 6.0).

5.3.5 Riparian Vegetation

Because dredging activities are concentrated in the center of the navigation channel and settling basins that support only subtidal habitats, the proposed dredging will not impact the riparian trees and shrubs which fringe portions of the lower Snohomish River. The proposed dredging is thus not expected to degrade the character or distribution of riparian vegetation, or to negatively affect the ability of listed species to benefit from the areas of riparian vegetation within the action area.

5.4 Cumulative, Interrelated, and Interdependent Effects

5.4.1 Interrelated and Interdependent Effects

Interrelated and interdependent effects of the proposed dredging include the continuation of commercial and recreational vessels utilizing the lower Snohomish River via the navigation channel. The proposed dredging safeguards navigation within the River by removing potentially hazardous areas of shoaling and maintaining the authorized depth of the navigation channel. The proposed dredging also removes shoaled sediments that would otherwise hinder safe navigation within the Everett Marina and at adjacent industrial, commercial, and recreational piers. These effects are not expected to increase due to the proposed dredging; rather they are a continuation of the current type and intensity of use in the lower Snohomish River.

5.4.2 Cumulative Effects

Under ESA, cumulative effects are limited to those effects of future, non-Federal projects that are reasonably certain to occur. The Corps knows of no non-Federal future projects in the vicinity of the Federal navigation project that are reasonably certain to occur.

6 EFFECT DETERMINATIONS

6.1 Summary of Effect Determinations

Table 2: Summary of Effect Determinations

Common Name	Scientific Name	Effect on Listed Species	Effect on Designated Critical Habitat
Marbled Murrelet	*Brachyramphus marmoratus*	May affect, but is not likely to adversely affect	No effect on designated critical habitat
Steller Sea Lion	*Eumetopias jubatus*	May affect, but is not likely to adversely affect	No effect on designated critical habitat
Puget Sound/Coastal Bull Trout	*Salvelinus confluentus*	May affect, but is not likely to adversely affect	May affect, but is not likely to adversely affect
Puget Sound Chinook Salmon	*Oncorhynchus tshawytscha*	May affect, but is not likely to adversely affect	May affect, but is not likely to adversely affect
Puget Sound Steelhead	*Oncorhynchus mykiss*	May affect, but is likely to adversely affect	No critical habitat is designated
Bocaccio	*Sebastes paucispinis*	No effect	No critical habitat designated
Canary Rockfish	*Sebastes pinniger*	No effect	No critical habitat designated
Yelloweye Rockfish	*Sebastes ruberrimus*	No effect	No critical habitat designated
Southern Resident Killer Whales	*Orcinus orca*	No effect	No effect on designated critical habitat

6.2 Bald Eagle

The bald eagle was de-listed from the Federal List of Threatened and Endangered Species effective August 8, 2007. In order to assure that bald eagles are not adversely affected, the US Fish and Wildlife Service also published guidance under the Bald and Golden Eagle Protection Act (BGEPA), including a definition of "disturb". The following analysis is prepared to identify whether a permit under the BGEPA would be necessary. Adult, sub-adult, and juvenile bald eagles are commonly sighted flying over or perched within the action area and are known to forage within and around Port Gardner Bay, Possession Sound, and the lower Snohomish River where they are year-round residents. Due to the industrialized nature of the lower Snohomish River and the lack of significant trees for nesting, there are no documented nests within the immediate vicinity of the proposed dredging. Similarly, wintering bald eagles do not generally concentrate along the lower Snohomish River. The nearest bald eagle nests to the dredging operations are all located at least two miles from either settling basin; recent bald eagle nesting has been documented west of the mouth of the main channel near Tulalip Bay and Priest Point and to the east of the main channel on Otter Island. Since bald eagle nests are relatively far removed from the project area, and other seasonal use in the project area is relatively light, and the project action results in discountable effects to the environment, we conclude that no permit under BGEPA is required for upland disposal of dredged material from the Snohomish River.

6.3 Marbled Murrelet

6.3.1 Background.

The marbled murrelet was listed as a threatened species in California, Oregon, and Washington under the Endangered Species Act of 1973, as amended in October 1992. Primary causes of population decline include the loss of nesting habitat in old-growth forests, and direct mortality from gillnet fisheries and oil spills while foraging in marine waters. Critical habitat for the marbled murrelet was officially designated on May 24, 1996. Designated critical habitat includes only terrestrial nesting habitat within designated critical habitat units and does not include marine foraging habitat. Marbled murrelet critical habitat includes 11 designated units in Washington State, including 1.2 million acres of Federal land, 421,500 acres of State forest land and 2,500 acres of private land.

The subspecies of marbled murrelet occurring in North America ranges from Alaska's Aleutian Archipelago to central California. Marbled murrelets forage in the near-shore marine environment and nest in inland old-growth coniferous forests of at least seven acres in size. Marbled murrelets typically forages for prey during the day and visits its nest site in the canopy of old-growth forests at dawn or dusk.

Marbled murrelets spend most of their lives in the marine environment, where they forage in areas 0.2 to 1.2 miles offshore. Murrelets forage by pursuit diving in waters generally up to 260 feet deep. Murrelets often aggregate near localized food sources, resulting in a clumped distribution. Marbled murrelets feed on a wide variety of small fish and invertebrates, indicating their flexibility and capability to use alternative prey sources, including herring, sand lance, anchovy, osmerids, sea perch, sardines, rockfish, capelin, smelt, as well as euphausiids, mysids,

and gammarid amphipods. Marbled murrelets also aggregate, loaf, preen, and exhibit wing-stretching behaviors on the water. While areas of marbled murrelet concentration at sea are likely determined by a combination of terrestrial and marine conditions, proximity to terrestrial nesting habitat appears to be the most important factor affecting marbled murrelet distribution and numbers.

Thus, although marine habitat is critical to marbled murrelet survival, USFWS' primary concern with respect to declining marbled murrelet populations is loss of terrestrial nesting habitat. Loss of old growth nesting habitat, entanglement in drift gillnets, negative effects from exposure to contamination, underwater noise, and natural and anthropogenic (human-induced) variability in prey availability are concerns for this species. Also, noise from human activity such as pile-driving has been of increasing concern. Marbled murrelets are considered mobile and opportunistic enough to avoid the immediate vicinity of such disturbances, but observers are being used to monitor effects of those activities.

6.3.2 Occurrence in the Project Area

Marine observations of murrelets during the nesting season are believed to correspond to the presence of large blocks of suitable nesting habitat inland. There are no suitable nesting areas in close proximity to the lower Snohomish River, Port Gardner Bay, or Possession Sound. Similarly, no designated critical habitat (i.e. terrestrial nesting habitat) is located in or along the shores of Puget Sound, the Snohomish River, or Possession Sound. Designated critical habitat does not include marine foraging habitat.

The closest nesting areas to the lower Snohomish River are located between 13 and 30 miles to the east in the Cascade Mountains east of Lake Stevens and north of Sultan (approximately 34 records) and approximately 35 miles west in Olympic Mountains, west of Port Hadlock and Port Townsend (approximately 15 records) (WDFW 2008).

During the breeding season, marbled murrelets are present along almost all of Washington's marine shoreline, concentrated in areas with abundant food and nearby nesting habitat. These areas of concentration are Tongue Point, the south shore of Lopez Island, the southwest shore of Lummi Island, and Obstruction and Peavine Passes between Orcas and Blakely Islands in the San Juan Islands (Seattle Audubon, www.birdweb.org).

In some, if not all portions of their range, marbled murrelets exhibit seasonal redistributions of their populations. In Washington, marbled murrelets move from the outer, exposed coasts of Vancouver Island and the Straits of Juan de Fuca into the sheltered and productive waters of northern and eastern Puget Sound (Speich and Wahl 1995). Areas of winter concentration are the southern and eastern end of the Strait of Juan de Fuca, Sequim (Clallam County), Discovery and Chuckanut Bays (Whatcom County), the San Juan Islands (San Juan County) and Puget Sound. The southern Washington coast is also considered an important wintering area (Seattle Audubon, www.birdweb.org). This may concentrate a large portion of the regional population into areas with heavy ship traffic, and increase their potential to encounter industrial and oil pollution in these sheltered waters.

Although appropriate foraging habitat is available in central Puget Sound, including Possession Sound, and Port Gardner Bay, marbled murrelets are not commonly seen in either of these areas, but could occur in the vicinity of the PSDDA disposal sites. The industrialized nature and shallow depths of the lower Snohomish River make the occurrence of marbled murrelet in the vicinity of the proposed dredging extremely unlikely.

6.3.3 Effects of the Action

Potential effects of the proposed maintenance dredging on marbled murrelets primarily include disturbance and increased turbidity during dredging operations that may inhibit foraging or result in temporarily reduced food availability and reduced visibility/detectability of prey. Noise of the dredges and temporary increases in turbidity during dredging will likely cause prey fish to avoid the immediate area of the dredging operations. Consequently, in the unlikely event that a marbled murrelet was present within the immediate vicinity of the dredging areas, they would be expected to temporarily avoid the immediate area and forage elsewhere until dredging operations are completed. The addition of the dredge noise in the localized area of the navigation channel does not appreciably add to disturbance noise for marbled murrelets, particularly since the activity of the dredge operation is confined to the river, and the noise is buffered by the presence of Jetty Island. The Corps expects that marbled murrelets will stay away from any active dredge, and the underwater sound generated by dredging will not cause changes in behavior of these animals as they are likely to have become somewhat habituated to vessels and associated underwater sound.

Marbled murrelets seldom utilize riverine habitats, preferring instead to forage in marine waters. The action area represents a small portion of the foraging habitat locally available for marbled murrelets within Puget Sound, so any such interference with murrelet foraging activity is expected to be insignificant and discountable, ending when the dredging and disposal activities are completed.

Any interference with murrelet activity will end when dredging and disposal is completed. Marbled murrelet prey availability should also not be substantially affected while the benthic community reestablishes along the dredge channel and within the disposal areas. Long-term degradation of marine foraging habitat is not expected. Survival and reproductive success of marbled murrelet will be unaffected due to the lack of appropriate nesting habitat within the action area.

For the reasons described above, no significant cumulative, interrelated or interdependent effects on the marbled murrelet are expected from the proposed dredging and disposal activities when considered in conjunction with other projects or actions.

6.3.4 Determination of Effect

Proposed maintenance dredging and disposal activities will not result in any long-term degradation of habitat or other significant adverse effects on marbled murrelets. Short-term effects such as noise disturbance and reduced prey availability will either not occur or will be very small in magnitude, as discussed above. Temporary disturbance to foraging activities are expected to be insignificant and discountable. The survival or reproductive success of marbled

murrelets in the project vicinity would not be affected. Therefore, the proposed maintenance dredging activities **may affect, but are not likely to adversely affect** the marbled murrelet. The proposed project will have **no effect** on designated critical habitat for marbled murrelet since the nearest critical habitat is terrestrial and many miles from the location of the work.

6.4 Steller Sea Lion

6.4.1 Background.

The Steller sea lion (*Eumetopias jubatus*) was listed as threatened under the Endangered Species Act on November 26, 1990. Critical habitat was designated in 1993, but does not include any areas within the state of Washington. The listing followed a decline of about 64% in the U.S. population over a period of roughly three decades. In 1997, the population of Steller sea lions in the North Pacific region was split into two separate stocks by NMFS, based on demographic and genetic differences (Bickham et al. 1996, Loughlin 1997). The stock separation resulted in the status of the western stock (Kenai-to-Kiska region; west of 144 degrees west longitude) being changed to endangered, leaving the status of the eastern stock unchanged as threatened. Thus, all stocks to the east and south of Prince William Sound, including those inhabiting the waters of Puget Sound and the Washington coast, remained classified as threatened.

Results of tagging studies have suggested that Washington's Steller sea lion population may be important for mixing of and foraging by populations that generally breed in Oregon, British Columbia and southeast Alaska. Although animals of all ages have been observed in the Washington population, no breeding rookeries have been identified in Washington, with the Oregon and British Columbia coasts being the closest breeding locations (Jeffries et al. 2000).

Land sites used by Steller sea lions are referred to as rookeries and haul-outs. Rookeries are used by adult sea lions for reproductive activity and by adult females for pupping and nursing from late May until July. Haul-outs are used by the entire Steller sea lions community as onshore rest areas, for socializing, but generally are not used for breeding.

6.4.2 Occurrence in the Project Area

It appears the Steller sea lion population found at Washington varies significantly throughout the year and perhaps between years. Steller sea lions are known to migrate into Puget Sound and have been seen in many inland water areas, including the San Juan Islands, rock outcroppings along the Strait of Juan de Fuca, near Everett, in Shilshole Bay, off the Ballard Locks and occasionally in south Puget Sound. There are no known annual counts and, as with the offshore area, their movements into Puget Sound seem sporadic. Following the large El Niño of 1985-1986, several hundred animals were reported to have appeared in south Puget Sound.

Steller sea lions may occasionally be found on navigation buoys in Puget Sound. Documented locations include: in the western Strait of Juan de Fuca around Pachena Point, on the Toliva Shoals buoy off the south tip of Fox Island, south of Gig Harbor, and several areas in southern British Columbia, including Race Rocks southeast of Becher Bay, Trial Island off of Victoria, and the Belle Chain area of the Gulf Islands (Jeffries et al. 2000). Thus, although Puget Sound

falls within the distribution of Steller sea lion, their numbers in the region are generally small and mostly concentrated in the northern portion of Puget Sound and the Strait of Juan de Fuca.

According to Gearin and Jeffries (1996), peak monthly counts indicate that Steller sea lions are most abundant off Washington during March through April and August through November. Steller sea lions may be observed along the Washington coast year around, but they are least abundant in May through July, which corresponds to the breeding time off Oregon and British Columbia.

Steller sea lions use haul out sites primarily along the outer Washington coast, from the Columbia River to Cape Flattery, as well as along the Vancouver Island side of the Strait of Juan de Fuca.

6.4.3 Effects of the Action.

Potential effects of the proposed maintenance dredging on Steller sea lions primarily include disturbance during haul out and inhibited foraging due to disturbance and increased turbidity during disposal of dredged sediments. Noise of dredges and temporary increases in turbidity during dredging will likely cause prey fish to avoid the immediate area of the dredging operations. Consequently, in the unlikely event that a Steller sea lion was present within the immediate vicinity of the dredging areas, they would be expected to temporarily avoid the immediate area and forage or haul out elsewhere.

Even if Steller sea lions were present while dredging was occurring, the noise and lights of the dredge and tugs could cause the seals and sea lions to avoid the area of dredging. The addition of the dredge noise in the localized area of the navigation channel does not appreciably add to disturbance noise for Steller sea lions, particularly since the activity of the dredge operation is confined to the river, and the noise is buffered by the presence of Jetty Island. The Corps expects that marine mammals will stay away from any active dredge, and the underwater sound generated by dredging will not cause changes in behavior of these animals as they are likely to have become somewhat habituated to vessels and associated underwater sound. Therefore dredging in the navigation channel would have insignificant effects to marine mammals and thus the project does not require a permit under the Marine Mammal Protection Act (MMPA).

Regarding underwater sound levels, the threshold for Level B harassment of marine mammals as established by NMFS is 120 dB for non-pulsed noise, which would apply to the hydraulic cutterhead dredge, and 160 dB for pulsed noise, which would apply to the mechanical (clamshell) dredge. The ambient noise generated by frequent shipping in the channel is very close to the disturbance thresholds for marine mammals (160 dB) identified by the National Marine Fisheries Service, and over the disturbance threshold for marbled murrelet (150 dB) identified by the US Fish and Wildlife Service. The addition of the dredge noise in the localized area of the navigation channel probably does not appreciably add to disturbance noise for marine mammals and marbled murrelets, particularly since the activity of the dredge operation is confined to the river, and the noise is buffered by the presence of Jetty Island. Furthermore, marine mammals are not expected to utilize the riverine environment outside of occasional forays into the river.

Because the action area represents a small portion of the foraging habitat locally available for Steller sea lions within Puget Sound and they do not commonly forage within this area, any such interference with Steller sea lion foraging activity is expected to be insignificant and discountable, ending when the dredging and disposal activities are completed. Noise and activity levels during the dredging and disposal activities are expected to be within the range of recurrent ambient levels within these industrialized areas and are thus not expected to be substantially above baseline levels or to affect the any Steller sea lion that could be present within the action area during dredging or disposal activities.

In the unlikely event that Steller sea lions were hauled out on the docks near the downstream settling basin, any temporary disturbance with their activities will end when the dredging is completed. Steller sea lion prey availability should also not be substantially affected while the benthic community reestablishes along the dredge channel and within the disposal areas. Long-term degradation of marine foraging habitat is not expected. Survival and reproductive success of the Steller sea lion will be unaffected due to the lack of any breeding rookeries within the action area.

For the reasons described above, no significant cumulative, interrelated or interdependent effects on the Steller sea lion are expected from the proposed dredging and disposal activities when considered in conjunction with other projects or actions.

6.4.4 Determination of Effect

Proposed maintenance dredging and disposal activities will not result in any long-term degradation of habitat or other significant adverse effects on Steller sea lions. Short-term effects such as noise disturbance and reduced prey availability will not occur or will be very small in magnitude, as discussed above. Temporary disturbance to foraging activities are expected to be insignificant and discountable. The survival or reproductive success of Steller sea lions would not be affected. Therefore, the proposed maintenance dredging activities may **affect, but are not likely to adversely affect** Steller sea lions. The project will have **no effect** on designated critical habitat.

6.5 Steelhead

6.5.1 Background

Puget Sound steelhead were listed as threatened in May of 2007 (NMFS 2007). Critical habitat has not been proposed or designated.

Steelhead can spend up to seven years in freshwater prior to smoltification and then three years in salt water prior to first spawning. Steelhead are iteroparous (spawn more than once) whereas the Pacific salmon is semelparous (spawn once and die). In rivers that have steelhead populations, at least one life history stage of steelhead would generally be present year-round.

6.5.2 Occurrence in the project area

Most adult summer steelhead enter fresh water as sexually immature fish between May and October, but migration can extend from April to mid-December (Haring, 2002; Snohomish River Recovery Technical Team, 2008). At the time of entry, adult summer steelhead are several months to as much as a year from spawning. Feeding while holding and maturing in freshwater is minimal, so these maturing adult steelhead trout rely on their body fat reserves for sustenance.

Adult winter steelhead enter the Snohomish between November and early May as sexually maturing fish, with most of the returning adults a few weeks to several months from spawning (Snohomish Basin Recovery Technical team, 2008). Hatchery fish dominate the early part of the winter run timing, entering between November and February, while the wild winter-run fish typically enter January to April (Jackson, WDFW, pers. comm.; Snohomish Basin Recovery Technical team, 2008). There are few references available on estuarine use by steelhead adults. Everest (1973) found that some steelhead spent as long as 31 days in the Rogue River estuary after tagging. At the Corps' Chittenden Locks in Shilshole Bay, Tabor et al. (1994 and 1995) reported that steelhead released below the Locks had return times of 5-15 days and actual migration times through the ladder of 1 day or less. Pfeifer et al. (1989) found that spaghetti-tagged steelhead took as long as 22 days to return to the Locks after tagging.

Depending on the time of spawning and the water temperature during incubation, fry emerge from the gravel in spring or early summer three or more weeks after hatching (Barnhardt 1986). In the Sultan River, emergence begins in early June and continues through July (CH2MHill 2005).

For the Snohomish basin, wild juvenile steelhead typically spend two years in freshwater. As they grow throughout their first year, juvenile steelhead begin to distribute themselves throughout the system when they are able to maintain position in fast currents (> 50 mm fork length (FL)). In general, rearing habitats for juvenile steelhead trout exist throughout the basin where anadromous steelhead occur, including the lower river where the dredging takes place, however the highest concentrations likely occur upstream of the town of Snohomish (Jackson, WDFW, pers. comm.; Snohomish Basin Recovery Technical team, 2008). Smoltification and outmigration typically take place from April to mid-May (Snohomish Basin Technical Recovery Team, 2008). Similar to the smolt trapping data, peak juvenile steelhead collections in the estuary are concentrated between a brief period in May and June annually. However, juvenile steelhead observed in beach seine sets from April through October indicates the potential of an extended estuarine rearing period for a limited number of fish each year (Snohomish River Recovery Technical Team, 2008). The bulk of the freshwater out-migration to the estuary may take on the order of one to four weeks. Given the extended rearing period in freshwater and their large size as smolts, it is believed juvenile steelhead smolts out-migrate to offshore areas quickly and the transit time through the estuary is brief (Snohomish River Recovery Technical Team, 2008). For the Snohomish basin, wild steelhead typically spend 2 or 3 years in the marine environment prior to their first spawning migration.

6.5.3 Effects of Action

The proposed dredging window begins October 15 and ends February 15. Given the run timing for adult steelhead and the year round presence of juveniles it is very likely that both will be present during the proposed dredging period. Adult steelhead, and some smolts, tend to occur in deeper areas throughout the channel where the dredging will take place (Simenstad, 1990). Potential impacts of the action include entrainment, physiological responses such as elevated stress levels due to noise and other factors, gill injury due to prolonged exposure to increased turbidity levels, and behavioral responses to turbidity, noise, and presence of the dredge. Risk of entrainment is minimal because they are mobile, more pelagically oriented than demersal, and the occurrence of salmonids has been found to be insignificant in dredges (Simenstad 1990; McLeay et al. 1987; Servizi and Martens 1987,1991; Murphy et al. 1989, Northcote and Larkin 1989; Newcombe and MacDonald 1991). Factors affecting the physiological response include exposure time (both duration of dredging and residence time of the fish in the project area), shape and character of the suspended sediments, extent of the plume, and noise levels. Studies have shown that most fish can tolerate short periods of high turbidity, but prolonged exposure lead to gill damage which interferes with respiration. Salmonids tend to show greater sensitivity to turbidity than other types of fish (USACE, 1991). Sigler et al. (1988) reports that suspended sediments have been shown to affect fish functions such as avoidance responses, territoriality, and feeding and homing behavior. Hydraulic dredges tend to have little impact on turbidity levels, and the area were the clamshell dredge will be used, which can have a greater impact on turbidity than a hydraulic dredge, is a courser sandy substrate and therefore expected to settle out quickly. Also, under the 401 water quality certification from past dredging actions in the Snohomish River turbidity was closely monitored and consistently met water quality standards set by Washington Department of Ecology within the established mixing zone. Therefore physiological impacts are expected to be minor.

Behavioral responses such as delayed timing of upstream migration due to turbidity and noise are also a potential impact. Delayed migration has been shown to decrease reproductive success in some stocks (Simenstad, 1988). Clarke, et al (2000?), in a study of fish response to dredging operations, stated that: "Results indicate that fishes present in the James River, Virginia did not respond strongly to the presence of either an idle or active dredge." Clarke's study looked at spot *(Leiostomus xanthurus),* white perch *(Morone americana*), Atlantic croaker *(Micropogonias undulatus),* and menhaden *(Brevoortia tyrannus).* However, none of these fishes are migratory (or were not migrating at the time of the study), and thus their behavioral responses to dredging operations may be different from those of a fish that is intent on moving through an area as opposed to being resident in an area. There is little or no evidence to indicate whether or not turbidity and noise from dredging would cause a migration delay for adult steelhead (or other salmonids) and further research is needed looking into these effects specific to dredging on migrating salmonids, particularly steelhead as they tend to be present during established dredging windows (Simenstad, 1990 and Nightengale and Simenstad, 2001).

Van Derwalker (1967) found that steelhead responded maximally to sounds between 35 and 170 Hz, but the fish did not move more than 60 cm from the sound source. Construction-generated vibration would be in a low-frequency range, and salmonids may be able to hear only in low ranges (Hawkins and Johnstone 1978). Abbott (1972) observed no response at 600 Hz in rainbow trout which otherwise responded generally to signals at 150 and 300 Hz. It is possible

that vibrations below the hearing range of salmonids would still be perceived and might elicit a startle response. Operation of heavy equipment is likely to create vibratory disturbances in general; Hawkins and Johnstone (1978) said that Atlantic salmon were sensitive to sounds transmitted through substrate in a river environment. See section 5.2.3 regarding noise effects, and the two noise measurement studies conducted during dredging activities in the lower Snohomish River, in 2009 and 2010. The hydraulic dredge that would be used in the Snohomish River peaks at about 177 dB, and the mechanical dredge peaks at around 170 dB. As these levels are below the threshold for salmonid sound exposure the noise from dredging operations is not expected to disturb fish that may be in the vicinity at the time of dredging.

Typically dredging in rivers in the Northwest create a tear-shaped plume, the size of which can be affected by a variety of factors, including river flow, tide, and salinity. Impacts of this plume on migrating steelhead behavior may ultimately depend on the proportion of the migratory pathway in the river that is occupied by the plume (Simenstad, 1988). One study under controlled conditions indicated that homing ability of adult Chinook did not appear affected by short exposures to high concentrations of Mount St. Helens ash (Whitman et. al., 1982). The degree to which this study may apply to longer term exposure to lower levels of suspended dredge sediments is unclear.

Salmonids exhibit physiological and behavioral responses to suspended sediments (Newcombe and MacDonald 1991). Physiological effects can include gill trauma (Servizi and Martens 1987; Noggle 1978; Redding and Schreck 1987), and effects on osmoregulation, blood chemistry (Sigler 1988), growth, and reproduction. Behavioral responses include feeding disruption from olfactory and visual impairment (Sigler 1988); gill flaring; and curtailment of territorial defense (LaSalle 1988). Conversely, some protection against predation may be afforded salmonids in areas of suspended sediment (Gregory 1988). Suspension of sediments can increase biochemical oxygen demand (BOD), and reduce dissolved oxygen levels in the water. Juvenile salmonids may be naturally exposed to some elevation in suspended sediment levels in estuaries and in streams carrying heavy loads of glacial silt (Gregory and Northcote 1993). Therefore it is not inevitable that juvenile salmonids would suffer major impacts from such levels of turbidity, but ideal conditions tend more toward lower turbidity levels. Turbidity during dredging would be periodically monitored downstream of the project at a distance appropriate to allow for acceptable mixing and dilution of any released sediment, as allowed under the state regulations (Washington Administrative Code 173-201A-400). Should monitoring indicate that state water quality maximum standards for turbidity are exceeded, project work would be halted and modified such that standards can again be met.

Migrating adult salmonids utilize a complex array of signals to home in on natal streams. While the scientific data lead to the assumption that noise impacts should be insignificant, there is a chance that the combination of effects generated by dredges (i.e., noise, water chemistry, odors, suspended sediments) could operate together to cause some individual fish to be uncertain about continuing upstream, resulting in a delayed migration. Thus, in some riverine situations, dredging could interfere with migration timing, lower fitness of individual fish, and ultimately lower productivity. However, past water quality sampling in the Snohomish River during dredging suggests that suspended sediments quickly disperse and settle back to the bottom, since they are primarily composed of sands. Furthermore, due to the relatively low frequency of

dredging (once every two years in any given reach) and lack of organic sediment inputs, the water chemistry is not likely to be altered during dredging (i.e., only sands being dredged, which have little to no associated odors or chemical constituents).

The information from the above information regarding the conditions in the Snohomish River indicates that the effects of noise and chemistry that may be generated by a clamshell or a hydraulic dredge on migrating steelhead would be insignificant.

With regard to juvenile steelhead, they will likely only be present in low numbers as the majority of the rearing habitat is along the banks and upstream of the project area (Jackson, WDFW, pers. comm.). Even though peak smoltification and outmigration occurs from April to mid-May, low numbers of juveniles may be present year round. Outmigrants are expected to make their way to offshore areas quickly and the transit time through the estuary is brief (Snohomish Basin Technical Recovery Team, 2008). Therefore impacts to juveniles are expected to be minimal and discountable.

6.5.4 Determination of Effect

The Corps determines that the suite of effects from the proposed dredging is ***"not likely to adversely affect"*** Puget Sound steelhead.

6.6 Bull Trout – Coastal/Puget Sound Distinct Population Segment

6.6.1 Background

Bull trout were historically found throughout the Pacific Northwest, from Northern California to the upper Yukon and Mackenzie drainages in Canada. The USFWS issued the determination of threatened status for the coastal/Puget Sound distinct population segment in the federal register on November 1, 1999. Critical habitat was designated on September 26, 2005; it was updated effective November 17, 2010, though that did not change the designation of the action area as critical habitat.

Bull trout have more specific habitat requirements as compared to other salmonids, generally restricting their spawning and juvenile rearing to high quality habitats. Particularly important requirements are water temperature, cover, channel form and stability, valley form, spawning and rearing substrates, and migratory corridors. Bull trout prefer deep pools of cold rivers, lakes, and reservoirs, often seeking out the coldest water in a watershed (USFWS 1999a). Streams with abundant cover (cut banks, root wads, and other woody debris) and clean gravel and cobble beds provide the best habitat. Their preferred summer water temperature is generally less than 55°F, while temperatures less than 40°F are tolerated. Spawning during fall usually starts when water temperatures drop to the mid- to low-40s. Cold, clear water is required for successful reproduction (USFWS 1999a).

Juvenile bull trout, particularly young of year, also have very specific habitat requirements. Small bull trout are primarily bottom-dwellers, occupying positions above, on, or below the stream bottom. Good hiding cover is also important to all life stages of all forms of bull trout.

Fry and juveniles can be found in pools or runs in close proximity with cover provided by boulders, cobble, large woody debris, and undercut banks. Age 1+ and older juveniles utilize deeper, faster water than underyearlings, often in pools with shelter-providing large organic debris or clean cobble substrate. In large rivers, the highest abundance of juveniles can be found near rocks, along the stream margin, or in side channels (Pratt, 1984, 1992; Goetz, 1994).

Current information suggests that bull trout first enter tidally influenced waters in Puget Sound as age-2 fish, at sizes ranging from 110 to 200 mm (Kraemer 2003; Yates 2001; Tanner et al. 2002; E. Jeanes, R2 Resource Consultants, Mindy Rowse, NOAA, E. Beamer, Skagit Systems Cooperative, unpublished data). The seasonal timing of entry extends from mid-February to early September, with the vast majority of juvenile fish entering tidal waters between April and July. A cumulative frequency analysis of WDFW catch data (over 2000 fish) from a scoop trap on the Skagit River near Mt. Vernon shows that 98 percent of all the fish were captured between April 1 and July 31 with approximately 0.2 percent captured in February and 1.0 percent in March and 0.6 percent in August and September (Dave Seiler, WDFW, unpublished data). Upon entry the juvenile fish may elect to rear in the tidally influenced delta within intertidal marsh, distributary channels, or along mainstem habitat areas, or may pass through these areas into nearshore marine waters. Larger juveniles may elect to migrate substantial distances through the nearshore marine environment from their natal river basin to adjacent areas. The longest documented migration of a larger juvenile or small sub-adult bull trout was from one of the western Olympic Peninsula Rivers, Quinault, Hoh, or Queets River, to the Willapa River. A single fish approximately 200-250 mm was captured at RM 29 in the Willapa River in May 2002 (J. Chan, USFWS, pers. comm.), this fish would have migrated a minimum of 60 to 100 miles from a known spawning river to get to the Willapa River.

There has been little information available regarding the use of off-channel floodplain areas by migratory (fluvial, adfluvial, and anadromous) bull trout in larger mainstem rivers. Prior to 2002, reports of bull trout use of floodplain areas in western Washington were not available. Recent review of gray literature and personal contacts shows that sub-adult and adult bull trout use lower elevation floodplains in freshwater and tidally influenced areas.

Subadult bull trout have been observed or captured in three restored and two natural tidal channels and in larger distributary channels of the Snohomish and Skagit Rivers, including locations upstream of the upstream settling basin: 1) the Snohomish River, in two small tidal channels off Ebey Slough, a large distributary channel that connect with Steamboat Slough (M. Rowse, NMFS, unpublished data); 2) the Snohomish River, in Union Slough during the first spring after dike removal and restoration of a previously isolated floodplain area on Spencer Island (Tanner et al. 2002); 3) the Snohomish River, subadult and adult bull trout have used portions of all three distributary channels – Union, Steamboat, and Ebey Sloughs in upstream and downstream migratory movements during spring, summer and fall, 2002 (F. Goetz, USACE, unpublished data); 4) the South fork Skagit, in Deepwater Slough, a moderate-sized tidal channel in a floodplain area previously isolated from the river and tides until reconnection occurred in October 2000 as part of a estuary restoration project (J. Klochak, Skagit System Cooperative, pers. comm.); 5) the Skagit River, adult and subadult bull trout have been recorded migrating through both forks during upstream and downstream migratory movements (F. Goetz, USACE, unpublished data).

Bull trout utilize the productive shallow waters or estuaries and nearshore marine areas to forage on a variety of prey items, but appear to target juvenile salmonids and small marine fish such as herring, sand lance, and surf smelt, especially keying in on forage fish spawning beaches (Kraemer 1994). Evidence suggests that June is a month where bull trout may aggregate in the outlet of major estuaries seeking outmigrating juvenile salmon as a preferred prey source.

In the Seattle District acoustic telemetry study, the highest density of tagged fish were found in an aggregation at the outlet of the Snohomish River at the peak of the juvenile Chinook salmon outmigration in late June 2002. In 2001 at Shilshole Bay, the highest number of adult bull trout caught at one time (three fish in one seine haul), were caught immediately below the smolt passage way at the beginning of the peak of Chinook salmon outmigration (F. Goetz, USACE, pers. comm.). Only 2 published reports have examined bull trout stomach contents and published the results (Footen 2000, 2003) - these fish ate 40 percent salmon and 60 percent sand lance and surf smelt. Recent analysis from the Hoh River shows that late winter prey by bull trout found in the lower river is 95 percent surf smelt (S. Brenkman, NPS, pers. comm.).

6.6.2 Occurrence in the Project Area

Distribution of Bull Trout in Puget Sound

The current distribution of bull trout within Puget Sound marine waters is not completely known, but has been documented from the Canadian border to at least the Nisqually River delta to the south. Bull trout migrate and are captured throughout the inner bays of northeast Puget Sound from Possession Sound, Port Susan, Skagit Bay, Padilla Bay, out to Whidbey Island (F. Goetz, USACE, unpublished data). One bull trout tagged in the Nooksack River was later recovered in the Lower Fraser River (N. Currence, Nooksack Tribe, pers. comm., 2003). It is thought that bull trout primarily use the shallower nearshore waters along the eastern shore of Puget Sound (waters less than 100 feet deep), and occasionally use or cross deeper waters (up to 100 foot depth) to access locations along the west side of Whidbey Island. It is unknown if individuals from Puget Sound populations migrate to the west side of Puget Sound as far west as the Strait of Juan de Fuca, and to what extent they may migrate up the coast of British Columbia.

Distribution and Movement of Bull Trout in the Lower Snohomish River

Within the Snohomish River basin, reproducing populations of bull trout are found in the upper North Fork Skykomish River mainstem and its tributaries between Bear Creek Falls and Deer Creek Falls; 1993 telemetry work documented spawning in the lower East Fork Foss River, tributary to the South Fork Skykomish River (WDFW 1998). Bull trout may also use the estuaries and reaches of river systems that have not historically supported spawning populations of bull trout, such as the Samish River, Shilshole Bay, and Duwamish River. Bull trout are believed to be foraging on juvenile salmonid outmigrants or other fish species while occupying these areas.

Bull trout migrate through the lower Snohomish River to and from upper basin areas that may include spawning areas in the upper North Fork and South Forks of the Skykomish River. The

Corps telemetry study has documented their use of the lower river and estuary for foraging, particularly during periods of juvenile salmonid out-migration.

While some bull trout may move downstream in response to the onset of fall rains, the majority of the fish in which we documented this behavior moved downstream only as far as the upper limit of tidal influence (at or above RM 15 in the Snohomish River and at RM 11 in the Skagit River), well upstream of the areas of proposed dredging (up to RM 6.3). The four fish that moved completely or partially through the estuary toward marine waters did so during the early portion of the dredging window (mid-November), returned to the upper basin by early December, and then did not reenter marine areas again until early March 2003. Except for these brief periods of movement in response to rainfall/high flow events, the results of the telemetry study indicate that bull trout are not likely to be present within the lower Snohomish River during the period of the proposed dredging.

The following information is based on preliminary results of the Seattle District Corps' acoustic telemetry study of bull trout in the Snohomish River estuary and nearby marine areas, conducted as part of the Corps strategy to minimize potential effects on bull trout and address concerns raised by USFWS during previous consultations for the maintenance dredging project.

Data from the Seattle District study has shown that sub-adult and adult bull trout show a variety of migratory behaviors in estuarine and marine waters, as described in more detail below, including: 1) inter-basin migrations through marine waters whereby fish using a particular estuary may have come from various nearby river basins, 2) periodic movement between fresh and saltwater, returning to non-natal rearing areas during the winter, 3) selection of a territory they may occupy for up to four months (winter, spring, and early summer) and that they may return to year after year.

Inter-basin Migrations Through Marine Waters

Migration by individual bull trout throughout river basins is a frequent occurrence in fresh water and is well documented. However, prior to the Corps study, migration by bull trout between basins through estuarine and marine waters had little documentation. In the first two years (2002-2003) of the Seattle District acoustic telemetry study in the Snohomish River estuary and nearby marine areas, over 50 percent of the reported detections for fish who left the Snohomish River estuary during late spring and early summer have occurred in the Skagit and Stillaguamish River basins. These fish (sub-adult and adult) have been reported or detected throughout the Skagit River basin, from the Whitechuck River, the Upper Sauk, mainstem Skagit below the Baker River, and down to the estuary. These fish were originally tagged at various places including the upper and lower Snohomish River and the nearshore marine shoreline north of the estuary (Port Susan). Bull trout tagged in the nearshore marine areas have been found entering and using the lower Stillaguamish River. Based on these initial study results, there is likely a large degree of mixing of core-populations within estuarine and marine nearshore areas of Puget Sound.

Similarly, in the first year of study, 98 percent of all tagged fish (49 of 50) left the tidally influenced areas by July 31, migrating upstream into the Skagit and Skykomish Rivers, with one fish remaining in freshwater tidal areas until August 12. These fish likely were either seeking

spawning areas or thermal refuge from warmer lower river temperatures. Thus, the majority of the tagged fish moved out of the areas which would be impacted by the proposed dredging well before the opening of the proposed dredging period in mid-October..

Periodic movement between fresh and saltwater
Bull trout may move downriver and/or reenter marine waters for a limited period during fall in response to the onset of fall rains or freshets. This sort of fall weather change in 2003 resulted in fish movement from upriver areas to mostly lower river sites (at or above freshwater tidal), with a small number of fish reentering marine waters to return to previous spring foraging areas.

During mid-November 2002, up to 20 of the tagged bull trout (out of 60 fish tagged, 50 fish redetected) moved downstream, with four fish reentering marine waters for a brief period of time. Their movement occurred immediately after the first rain and consequent increase in river flow following four months of drought. The first rain in four months occurred on November 7, river flows were near a 60-year low, and river flows showed an increase beginning November 8, with highest flows occurring on November 20 and 21.

The majority of the tagged fish moved downstream only to the edge of tidal influence or above (RM 11 in the Skagit River, at or above RM 15 in the Snohomish River). The four bull trout that reentered marine waters did so on November 7, 9, 15, and 21, 2003, corresponding to onset of the rain and the increase in river flow. Three of the fish returned to marine waters from the Snohomish River and one from the Skagit River. Several of these fish returned to the marine areas where they were originally tagged in the spring of 2002. All of these fish then moved back upstream to freshwater areas by early December and did not reenter marine areas again until early March 2003.

The first fish reentering marine water left the Skagit River on November 7 and was detected in the upper Snohomish River on November 21. This fish was originally tagged in the upper Snohomish River in spring 2002 and left the Snohomish River on April 14, 2002. It appears to have spent the summer in the Skagit River near Sedro Woolley, and then returned to the upper Snohomish River between November 7 and 21. It then spent the winter rearing in the upper Snohomish River, and then returned to marine waters on April 1, 2003.

The second fish was detected in lower Skagit River on November 9, 2002. It had been tagged at Kayak Point (between the Snohomish River and the Stillaguamish River) the previous spring, had left marine waters in late July 2002 to return to the Skagit River. It then left the Skagit River on November 9, was detected at Kayak Point on November 15, was heard intermittently until December 12, and was not heard again at Kayak Point until April 14, 2003.

The third fish was heard on November 15, 2002 at Kayak Point, it reentered the upper Snohomish River on November 19. The fourth fish was detected in Steamboat Slough on November 21, 2002 and had returned to the upper Snohomish River by November 27, 2002.

Selection of a feeding territory
Bull trout may home to a feeding territory that they may occupy for up to four months (winter, spring, and early summer). Examples of these territories were found in all areas of the estuary -

freshwater tidal, brackish intertidal, and nearshore marine. Both adult and sub-adult fish displayed this behavior. Bull trout may also return to this feeding territory year after year. Approximately ten percent of all tagged fish returned to the location of tagging the previous year. These territories may range in size from 1 to 2 kilometers in size and from 100 to 500 meters in shoreline length.

6.6.3 Effects of the Action

The occasional adult or sub-adult bull trout which may be migrating through the lower Snohomish River during the period of the dredging operations is likely to avoid the area of the dredge and its zone of temporarily increased turbidity. This is primarily because they are non-migratory, and are more than likely simply moving opportunistically for reasons unknown to us. Therefore, they would be able to avoid the dredging area by seeking refuge over the shallow intertidal areas along either side of the navigation channel and settling basins. Thus the potential effects to upstream migration detailed for steelhead (Section 6.5.3) to not apply to bull trout. Foraging habitat, such as these intertidal areas, would not be affected by the dredging. Populations of prey important to bull trout (juvenile salmon and forage fish) are unlikely to be affected by the proposed dredging and disposal operations (see Sections 5.3.1.1 and 5.3.3).

This information, in combination with the conservation measures described below in Section 6.5.5, particularly avoidance of the juvenile salmon migration period, is expected to prevent adverse short-term effects to bull trout during dredging and disposal operations. The temporary loss of the benthic and forage fish communities during dredging is expected to have a negligible effect on long-term habitat quality within the action area. Overall, the effects of the proposed action would be insignificant and discountable due to the temporary duration of the dredging activities and the implementation of the proposed conservation measures to minimize the potential for bull trout to be within the action area during dredging.

Dredging would result in temporary degradation of the water quality; these effects would be limited to the immediate dredging site and bull trout are believed to readily be able to avoid areas with temporarily degraded water quality conditions. The temporary loss of the benthic and forage fish communities in the dredging areas would have only a negligible effect on bull trout habitat, especially since juvenile bull trout forage mainly outside of the navigation channel. In the event that an occasional bull trout would be migrating through the dredging areas in response to rainfall events, they would be expected to readily avoid the project area during dredging operations by utilizing undisturbed habitats along the edges of the navigation channel.

6.6.4 Critical Habitat

The following primary constituent elements (PCEs) were given for bull trout in the Federal Register (October 18, 2010) in the re-designation of critical habitat.

(1) Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia. *Springs, seeps, and groundwater sources are not affected by the proposed action, as water movement is not affected by dredging.*

(2) Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.
The proposed action may have a temporary affect on migrating salmonids (see especially discussion in 6.5), primarily in the form of temporary elevation of turbidity and noise levels, which are considered to be insignificant. No permanent barriers to migration would result from dredging activities.

(3) An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
Other than seasonal disruption of benthic and epibenthic food sources, dredging would have an insignificant effect on the food base in the lower Snohomish River.

(4) Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.
Dredging would occur only within the thalweg (main channel) of the lower Snohomish River and would not result in direct effects to side channels or banks. The substrate consists almost entirely of unembedded sand, not appropriate for spawning. Also, spawning does not occur in this reach, so the absence of variety in pools, gradients, velocities and structure that result from dredging is not a significant effect on this PCE.

(5) Water temperatures ranging from 2 to 15 °C (36 to 59 °F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.
Average temperature recorded during the window of the proposed dredging (October 1 through February 14) was 6.3°C. The highest temperatures during the proposed dredging period have generally occurred in mid-October, with high temperatures of 14.1°C on October 6, 1980, 11.8°C on October 19, 1993, 11.7°C on October 18, 2005, and 11.5°C on October 16, 2006. Lowest readings during the proposed dredging period have been 0.1°C, recorded on January 28, 1980. Thus, dredging is not expected to elevate water temperatures beyond the ideal temperature range for bull trout.

(6) In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.
The lower Snohomish River is not utilized by bull trout for spawning or rearing; this PCE would not be affected by the proposed project.

(7) A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

The proposed dredging project would not alter the hydrograph of the lower Snohomish River.

(8) Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.
The proposed project would not alter the quantity of water in the lower Snohomish River. The proposed project would have a temporary, insignificant effect on turbidity.

(9) Sufficiently low levels of occurrence of nonnative predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.
The presence or abundance of such predatory species, if they occur in the lower Snohomish River, would not be affected by the proposed dredging project.

In summary, the action area serves primarily as migratory habitat for coastal/PS bull trout. As in most of the Puget Sound rivers, the PCEs in the action area have been significantly altered. Dredging and disposal activities result in impacts to substrates, habitat complexity, water quality and noise (though the latter is not specifically listed as a component of critical habitat).

As discussed in previous paragraphs, these impacts are minor, temporary, and discountable, and do not interfere with movements of bull trout.

6.6.5 Determination of Effect

For the reasons described above, no significant cumulative, interrelated or interdependent effects on bull trout are expected from the proposed dredging and disposal activities when considered in conjunction with other projects or actions.

Overall, the effects of the proposed action on Coastal/Puget Sound bull trout would be insignificant and discountable. Therefore, the proposed maintenance dredging activities may affect, but is **not likely to adversely affect** Coastal/Puget Sound bull trout or its designated critical habitat.

6.7 Chinook Salmon

6.7.1 Background

The Puget Sound evolutionarily significant unit of Chinook salmon (*Oncorhynchus tshawytscha*) was listed as a threatened species in March 1999. Critical habitat was designated September 2, 2005.

Like all Pacific salmon, Chinook reproduce in fresh water but spend the majority of their life cycle in the marine environment. Chinook remain at sea an average of two to four years before returning to their natal stream to spawn. Chinook salmon prefer to spawn and rear in the mainstem of rivers and larger streams (Williams et al. 1975, Healey 1991). Chinook are generally classified either as ocean or stream type. Ocean-type fish are characterized by a short

juvenile freshwater residence time and normally migrate to estuarine areas within their first year (usually around three to four months after emergence from spawning gravel). They typically return to their natal stream a few days or weeks before spawning. Stream-type Chinook typically spend one or more years in fresh water before migrating to the sea and often return to their natal streams several months prior to spawning. The majority of Puget Sound Chinook salmon, including those from the Snohomish River are ocean-type, which migrate out of the river, through the estuary, and into marine waters as sub-yearlings.

Estuaries are an important rearing habitat for all species of salmon, but Chinook are probably the most dependent on this type of habitat (Healy 1982). Rivers with well-developed estuaries are generally able to sustain larger ocean-type populations than those without. Salmon use estuaries for rearing, refuge from predators, and as a physiological transition area (Simenstad et al 1982). Juvenile Chinook rear in estuaries for a period of days to two months. They range in size from 35 to 160 mm in length when entering the estuary (Beauchamp et al 1983). Ocean-type Chinook are usually smaller and tend to utilize estuaries and coastal areas more extensively for rearing than stream-type juveniles (Healey 1991).

Chinook smolts spend a prolonged period (several days to several weeks) during their spring outmigration feeding in salt marshes and distributary channels as they gradually transition into marine waters. This feeding and growth period allows them to reach a size that helps prepare them for their first winter at sea. Rapid growth occurs in estuaries due to the abundance of preferred prey including larval and adult insects and epibenthic crustaceans such as gammarid amphipods, mysids, and cumaceans. As Chinook juveniles mature and move into marine waters, they feed on drifting insects and small nektonic organisms (calanoid copepods, crab larvae, larval and juvenile fish, and euphausiids) (Simenstad et al. 1982; Healey 1991).

6.7.2 Occurrence in Project Area

The natural spawning populations of Chinook salmon within the Snohomish River system are separated into two distinct stocks: Skykomish Chinook and Snoqualmie Chinook (WDFW 2002 SASSI), both of which are considered to be depressed.

Adult Chinook migrate into the Snohomish River estuary and upstream to their natal streams between September and October. Juvenile Chinook salmon are generally then present in the Snohomish River estuary from March through July or August, with peaks in outmigration generally occurring in May and June.

In Puget Sound, designated critical habitat for Chinook salmon includes all marine, estuarine, and river reaches accessible to the species. Thus, all of the waters within the project area are within the designated critical habitat for Chinook salmon.

6.7.3 Effects of the Action

The occurrence of adult Chinook migrating through the action area during the dredging period (October 16 to February 14) is unlikely based on the timing of adult upstream migration (July through September) and spawning (September and October). The dredging work window is designated to avoid the bulk of both upstream (adult) and downstream (juvenile) migration

periods. Juvenile foraging habitat, such as shallow intertidal areas, would not be affected by the dredging. Populations of prey important to juvenile and adult Chinook salmon (invertebrates and forage fish) may be affected by the proposed dredging and disposal operations, but these effects are expected to be insignificant and discountable due to their brief and temporary nature (see Sections 5.3.2 and 5.3.3). Similarly, Chinook salmon within the vicinity of the disposal sites (either the PSR Superfund site in Elliott Bay or the PSDDA site in Port Gardner Bay) would be expected to move out of the area of the bottom dump barge as sediments are falling through the water column; Chinook salmon would not be expected to be in the deeper waters where the sediments would settle.

This information, in combination with the conservation measures described in Section3.3, particularly avoidance of the juvenile salmon migration period, is expected to prevent adverse short-term effects to Chinook salmon during dredging and disposal operations. The temporary loss of the benthic and forage fish communities during dredging is expected to have a negligible effect on long-term habitat quality within the action area. Overall, the effects of the proposed action would be insignificant and discountable due to the temporary duration of the dredging activities and the implementation of the proposed conservation measures to minimize the potential for Chinook salmon to be within the action area during dredging.

6.7.4 Critical Habitat

The proposed action occurs in designated critical habitat for PS Chinook which includes the stream channels within the proposed stream reaches, and includes a lateral extent as defined by the ordinary high water line. Critical habitat must have features essential for the conservation of the listed species; these features can be identified as PCEs of the habitat (Table 3).

Table 3: Types of sites and essential physical and biological features named as PCEs in PS Chinook salmon critical habitat designation (NMFS 2008).

Site	Essential Physical and Biological Features	Species Life Stage
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity and floodplain connectivity	Juvenile growth and mobility
	Water quality and forage	Juvenile development
	Natural cover [a]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[b]	Juvenile and adult mobility and survival
Estuarine areas	Free of obstruction, water quality and quantity, and salinity	Juvenile and adult physiological transitions between salt and freshwater
	Natural cover[a] , forage[b] , and water quantity	Growth and maturation
Nearshore marine areas	Free of obstruction, water quality and quantity, natural cover[a], and	Growth and maturation, survival

	forage[b]	
Offshore marine areas	Water quality and forage [b]	Growth and maturation

[a] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.

The action area serves primarily as rearing and migratory habitat for PS Chinook. As in most of the Puget Sound rivers, the PCEs in the action area have been significantly altered. Dredging and disposal activities result in temporary and minor impacts to substrates, habitat complexity, water quality and noise (though the latter is not specifically listed as a component of critical habitat).

As discussed in previous paragraphs, these impacts are minor, temporary, and discountable.

6.7.5 Determination of Effect

Adult, sub-adult, and juvenile Chinook salmon utilize the lower Snohomish River and the larger action area. Therefore, the project may affect the threatened Puget Sound Chinook salmon. However, any Chinook salmon present would experience negligible effects from the proposed dredging operations, as described in Section6.7.3.

Conservation measures (as described in Section 3.3), including avoiding dredging during the migration period of juvenile Chinook salmon, would prevent adverse short-term effects to Chinook salmon during dredging operations. Dredging would result in temporary degradation of the water quality; these effects would be limited to the immediate dredging site and the timing of the dredging occurs during periods when Chinook salmon are likely not present in any abundance. The temporary loss of the benthic and forage fish communities in the dredging areas would have only a negligible effect on Chinook salmon habitat, especially since juvenile Chinook salmon forage mainly in intertidal areas outside of the navigation channel.

For the reasons described in Section 5.4, no significant cumulative, interrelated or interdependent effects on Puget Sound Chinook salmon are expected from the proposed dredging and disposal activities when considered in conjunction with other projects or actions.

Overall, the effects of the proposed action on Puget Sound Chinook salmon would be insignificant and discountable. Therefore, the proposed maintenance dredging activities may affect, but are **not likely to adversely affect** Puget Sound Chinook salmon. Similarly, the proposed maintenance dredging activities may affect, but are **not likely to adversely affect** designated critical habitat for Puget Sound Chinook salmon.

6.8 Bocaccio

Bocaccio are an elongated rockfish, of the scorpion fish family, that ranges from northern British Columbia to central Baja California. These fish were once quite common on steep walls of Puget Sound. However, due to declining numbers and increased rarity they were listed as endangered on April 28, 2010 (FR, 2010a). Adults generally occupy water 50- 250 meters in

depth over rocky outcroppings, boulder fields, and sloping walls and will school with both conspecifics and other species of rock fish. Occasionally these adults will migrate onto mudflats adjacent to rocky substrates. Adults can also be found well off the substrata up in the water column. Larval bocaccio are pelagic, drifting at the mercy of the currents, usually occupying surface waters. By age 3.5 months the young will settle and recruit to inshore waters. Juveniles are found in much shallower waters over rocky substrate with various understory kelps and/or sandy bottoms with eelgrass. Approximately one month after settling juveniles will start to school. Adults and large juveniles feed on small fish and squid, whereas larvae and small juveniles feed on copepods, krill, diatoms, dinoflagellates and various larvae (Love et. al, 2002).

6.8.1 Effects of Action

It is very unlikely that any adult bocaccio would occur in project area or the disposal sites as they tend to inhabit deeper water with rocky substrate. Although juveniles are present in shallower water, they are also associated with rocky areas with kelp cover and sandy areas with eelgrass beds. None of these habitats are present within the project area. There is probably no chance the larval stage of these species would be present at the project site because at this life stage they are pelagic drifters at the mercy of the currents (Tonnes, pers. comm., 2009).

6.8.2 Determination of Effect

Due to the lack of presence of bocaccio in the project area the proposed action is expected to have **"no effect"** on this species.

6.9 Canary Rockfish

Canary rockfish, a member of the scorpionfish family, range from northern British Columbia to northern Baja California potentially living to be 80+ years old. Due to declining numbers and increased rarity of canary rockfish in Puget Sound they were listed as threatened on April 28, 2010 (FR, 2010a). Adults occupy depths of 80-200 meters in areas with considerable current around pinnacles and high relief rock often schooling with both conspecifics and other species of rockfish. Larval canary rockfish are pelagic, at the mercy of the currents, and tend to be present in the upper 100 meters of the water column. After 3-4 months the pelagic juveniles settle onto shallow benthic substrates such as tide pools and kelp beds. As juveniles grow they start to group and move into depths of 15-20 meters at the interface between rock and sand during the day and then disperse onto the sand flats at night. The juveniles gradually move from shallower to deeper area towards the end of summer. Adults and subadults feed on small fish and invertebrates while juveniles feed on copepods, krill eggs and various larvae (Love et. al., 2002).

6.9.1 Effects of Action

It is very unlikely that any adult canary rockfish will be present in the project area or the disposal sites as they tend to inhabit deeper water with rocky and/or sandy substrate. Although juveniles tend to be present in shallower water, they are associated with rocky areas with kelp cover and/or areas with a rocky-sand interface. None of these habitats are present within the project area. There is probably no chance the larval stage of these species would be present at the project site

because at this life stage they are pelagic drifters at the mercy of the currents (Tonnes, pers. comm., 2009).

6.9.2 Determination of Effect

Due to the lack of presence of canary rockfish in the project area the proposed action is expected to have **"no effect"** on this species.

6.10 Yelloweye Rockfish

Yelloweye rockfish, a member of the scorpion fish family, range from the eastern portions of the Aleutian Islands to Northern California and can live up 118 years. Due to declining numbers and increased rarity they were listed as threatened on April 28, 2010 (FR, 2010a). Adults and subadults occupy areas rocky areas with refuge such as crevices, caves, and boulder piles. They are usually solitary but can co-occur with one to a few individuals of another species of rockfish. Occasionally, they will wander onto mudflats adjacent to rocky areas. Very little is known about the larval stage of yelloweye rockfish (year 1), but young juveniles can be found on vertical walls with cloud sponges and anemones at depths greater than 15 meters. Yelloweye rockfish spend the majority of their time on the substrata where they feed on small fish, shrimp, crab, and lingcod eggs (Love et. al, 2002).

6.10.1 Effects of Action

It is very unlikely that any adult yelloweye rockfish will be present project area or the disposal sites as they inhabit water with rocky substrate that provides refuge space and/or invertebrate cover. This habitat is not present within the project area. Although information is lacking for the larval portion of their life, like other species of rockfish it is highly unlikely that they would be present at the project site because at this life stage they are pelagic drifters at the mercy of the currents (Tonnes, pers. comm., 2009).

6.10.2 Determination of Effect

Due to the lack of presence of yelloweye rockfish in the project area the proposed action is expected to have **"no effect"** on this species.
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6.11 Southern Resident Killer Whales

6.11.1 Background

Due to declining population trends over the past few decades the southern resident killer whale (*Orcinus orca*) (SRKW) was listed as endangered on November 15, 2005 (NMFS, 2005). Critical habitat was designated November 29, 2006, consisting of the marine waters of Puget Sound, San Juan Islands and Strait of Juan De Fuca greater than 20 feet. Rivers and streams flowing into the Puget Sound are not designated as critical habitat.

Two types of killer whales are common to the greater Puget Sound area: transient and resident. The transient whales feed almost exclusively on marine mammals and their occurrence in Puget Sound is somewhat unpredictable. The resident killer whales are fish eating and occur in Puget Sound from early spring to late fall when the move both south and north along the coast for the winter. There are three pods of SRKW that frequent the Puget Sound, J, K, and L, with total current numbers hovering around 80 individuals. SRKW spend the majority of their time feeding mostly on salmon, preferably Chinook, along with a variety of other species of fish in the waters around the San Juan Islands and Southern British Columbia. However, in the fall the whales may expand their range and enter portions of the Puget Sound proper in pursuit of local salmon runs (Kreite, 2007). Fraser River salmon are prevalent among the Chinook in the diets of SRKW.

6.11.2 Effects of the Action

It is highly unlikely that a SRKW would enter a river mouth as the shallow depth and morphology of the dredged area likely limits their presence since they tend to require open waterways with no restrictions (NOAA, 2006). Also, the during the proposed dredge window SRKW are typically not present in the Puget Sound as they tend to move south and north along the western Pacific coast during the winter months. Furthermore, SRKW occurrences in river mouths are rare occurrences.

6.11.3 Critical Habitat

The PCEs for Southern Residents include the following: (1) Water quality to support growth and development; (2) Prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) Passage conditions to allow for migration, resting, and foraging.

The action area barely includes critical habitat for southern resident killer whale (shoreline of Puget Sound). However, the action addressed in this BE (dredging) does not directly affect the critical habitat, as the dredging occurs only in the river. Effects of transport of dredged material and disposal at the Port Gardner open-water disposal site are addressed in the PSDDA BE (Corps, 2010).

As discussed in previous paragraphs, impacts to water quality, prey base, and passage for other species are discountable. Effects to killer whale critical habitat are not anticipated.

6.11.4 Determination of Effect

Due to the lack of suitable and critical habitat within the project area and the absence of SRKW during the dredging window, the proposed action is expected to have **“no effect”** on southern resident killer whales and their designated critical habitat.

6.12 Essential fish habitat

Public Law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Act, which regulates fishing in US waters, to establish new requirements for “Essential Fish

Habitat" (EFH) descriptions in federal Fishery Management Plans (FMPs) and to require federal agencies to consult with the National Marine Fisheries Service (NMFS) on activities that would adversely affect EFH (PSMFC 2000). The Pacific States Fishery Management Council amended the Pacific Groundfish Fishery Management Plan and the Coastal Pelagic Species Management Plan (1998a, 1998b) to designate waters and substrate necessary for spawning, breeding, feeding, and growth of commercially important fish species.

The marine extent of salmon, groundfish, and coastal pelagic EFH includes those waters from the nearshore and tidal submerged environments within Washington, Oregon, and California state territorial waters out to the exclusive economic zone (370.4 km) offshore between the Canadian border to the north and the Mexican border to the south.

There are seven composite EFHs: estuarine, rocky shelf, non-rocky shelf, canyon, continental shelf/basin, neritic and oceanic habitats. The Corps maintenance dredging occurs exclusively in soft substrate areas within the Snohomish River navigation channel. Dredging could impact demersal fish species associated with the soft bottom of the river channel (such as skates, sanddab, soles, and flounders). Adult and juvenile Chinook, coho, and pink salmon utilize the habitats of the estuarine composite EFH.

Dredging will temporarily reduce the populations of benthic organisms that are prey species for various groundfish and juvenile pelagic fishes that utilize estuarine composite EFH. Benthic and epibenthic prey species will be temporarily displaced, but are expected to recover shortly (within one year) after dredging activities are completed. Since new invertebrate communities will eventually be established in the dredging areas, no long-term loss of biological productivity is expected as a result of the dredging and disposal operations (see Section 5.3.2). Similarly, forage species such as anchovy, sardine, and squid could also be temporarily impacted by elevated turbidity levels or reduced dissolved oxygen levels near the operating dredge. However, no long-term loss of forage species biological productivity is expected (see Section 5.3.3).

In order to conserve estuarine EFH and reduce potential effects on associated species, the proposed dredging operations would incorporate the following conservation measures:

- Employing a clamshell dredge to reduce potential entrainment of demersal species in 2010.
- Clamshell dredging will be shut down for at least two hours daily at the extreme ebb tide stages to promote compliance with turbidity standards, and also to facilitate with- and without-noise monitoring, and steelhead observations.
- Continued compliance with the provisions of the WDOE Water Quality Certification and short-term Modification to the Water Quality Standards authorizations relative to turbidity and dissolved oxygen during dredging operations.
- Employing a dredging window of October 16 to February 14 to minimize impacts to juvenile salmonids and during a period when bull trout are unlikely to be migrating within the lower river.
- Conducting maintenance dredging based on the results of site specific condition surveys conducted each year. These surveys determine the areas where the basins and

channel need to be dredged and help limit both the dredging area and duration to that necessary to maintain safe navigation. (NOTE: The settling basins are designed to capture sediments to concentrate dredging volumes, and thus minimize the footprint of dredging operations (e.g., preventing sedimentation within marinas). This helps to maximize the time interval between dredging and allow the benthic community to recover between dredging cycles to the greatest extent practical.

- Utilizing established PSDDA open water disposal sites with known latitude-longitude coordinates enables agencies to track cumulative impacts at these sites through a GIS database.

The Corps believes the combination of the conservation measures detailed above will reduce effects on Essential Fish Habitat to the point that the effects will be insignificant and discountable, and thus the proposed dredging operation may affect, but is not likely to adversely affect Essential Fish Habitat.

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