BIOLOGICAL ASSESSMENT
FY 2004-2005 MAINTENANCE DREDGING,
UPPER DUWAMISH WATERWAY,
SEATTLE HARBOR, WASHINGTON

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1.0 INTRODUCTION

This Biological Assessment (BA) addresses the effects of U.S. Army Corps of Engineers (Corps) fiscal years 2004-2005 routine maintenance dredging in the Duwamish Waterway, Seattle Harbor, Washington, on species under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS) that are protected under the Endangered Species Act (ESA) of 1973. The need for this BA derives from the potential occurrence in the project area of species that are listed, proposed, or candidates for listing under the ESA.

The National Marine Fisheries Service (NMFS) (currently known as National Oceanic and Atmospheric Administration (NOAA) Fisheries) has already concurred with effect determinations related to maintenance dredging in the Duwamish Waterway (NMFS 2001) through fiscal year 2005, as presented in the Biological Assessment prepared for Fiscal Year 2001-2005 Maintenance Dredging, Upper Duwamish Waterway (USACE 2000a). USFWS also concurred with the effect determinations made in that BA for dredging between October 16, 2001 and February 14, 2002 (USFWS 2001). USFWS did not, however, extend concurrence past February 14, 2002. Consequently, this BA has been prepared to evaluate effects of fiscal years 2004-2005 routine maintenance dredging in the Duwamish Waterway and focuses on only those species under the jurisdiction of USFWS (see Section 4.1).

As part of the U.S. Environmental Protection Agency's (EPA) planned remedial actions at the Pacific Sound Resources (PSR) Superfund Site, the sediment dredged from the Duwamish may be used to cap a portion of the Marine Sediments Unit (MSU) within the PSR Superfund Site. If the sediment were unacceptable for use as capping material (based on sediment analysis results), the dredged sediment would then be disposed of at the Washington Department of Natural Resources (WDNR) managed Puget Sound Dredged Disposal Analysis (PSSDA) open-water, non-dispersive disposal site in Elliott Bay.

Both USFWS and NOAA Fisheries (USFWS 2003, NMFS 2003b) have concurred with effect determinations related to capping of the MSU portion of the PSR Superfund site, as presented in a Biological Assessment prepared for the PSR Superfund Site (USACE and EPA 2002). Similarly, both USFWS and NOAA Fisheries have also concurred (USFWS 2000d, NMFS 2000) with effect determinations related to disposal of dredged material at the PSDDA open water site in Elliott Bay, as presented in the Programmatic Biological Evaluations prepared for the PSDDA Non-Dispersive Disposal Sites (USACE 2000b and 2000c). NOAA Fisheries has also concurred with Essential Fish Habitat consultation for the PSDDA open water disposal site (NMFS June 2, 2003b letter). Therefore, this BA will address effects from the disposal of dredged materials in a summary manner and will reference the more detailed material presented in the respective BA documents and concurrence letters.

1.1 Authority

The Seattle Harbor Federal Navigation Project and maintenance dredging is authorized by the River and Harbor Act of March 2, 1925 and July 3, 1930. Federal maintenance dredging is required within the lower 5.2 miles of the Duwamish River (also known as the Duwamish Waterway) on a one to three year frequency to remove annually shoaling river sediments. The

Corps is authorized to dredge a maximum of approximately 200,000 cubic yards of sediment between stations 254+00 and 275+56 every one to three years. This BA addresses proposed dredging activities through Fiscal Year (FY) 2005.

1.2 Project Location and Description

The dredging activities proposed for FY 2004 through FY 2005 are a component of the Seattle Harbor Federal Navigation Project, providing maintenance of the navigation channel in the upper Duwamish Waterway (lower Duwamish River) (Figure 1). Without annual maintenance dredging, shoaling would lead to a shallower channel that would reduce the ability of large ships to enter and leave safely.

Based on a condition survey in March 2003, the Corps proposes to dredge approximately 65,100 cubic yards of sediment in FY 2004 between stations 257+00 and 275+56, an area known as the Turning Basin at the upstream end of navigation channel (Figure 1). The channel width here is 150 feet with widening at the turn to approximately 250 feet (Figure 3). Dredging is accomplished using clamshell equipment, loading the dredged materials on to bottom dump barges.

The dredging and disposal activities will be performed between October 16 and February 14 of fiscal year 2004 and 2005 and will generally require approximately two to three weeks to complete. The Turning Basin was last dredged between January 14 and February 9, 2002 between stations 254+00 and 275+56.

Depending on the results of sediment analysis and field determinations made by the Corps Dredge Material Management Office, the sediment dredged from the Duwamish may be beneficially used to cap a portion of the Marine Sediments Unit (MSU) within the PSR Superfund Site (Figure 1). The MSU site is located approximately 0.3 miles west of the mouth of the Duwamish River's West Waterway; and is composed of five Remediation Areas (RAs). Dredged material from the proposed action could be used to cap RA5a and then RA5b within the MSU. The specific location and extent of areas RA5a and RA5b are illustrated in Figure 2.

If the sediment is unacceptable for use as capping material, the dredged sediment would then be disposed of at the WDNR managed PSDDA open water site in Elliott Bay (Figure 1), provided it passes all criteria for open water disposal. The PSSDA site is located at 47 degrees 35.96 minutes north latitude and 122 degrees 21.45 minutes west longitude (Figure 1). Disposal activities will be conducted in accordance with established criteria for either site, as detailed in their respective Biological Assessments and concurrence letters (USACE 2000b and 2000c, USFWS 2000d, NMFS 2000, NMFS 2003b, USACE and EPA 2002, USFWS 2003, NMFS 2003a).

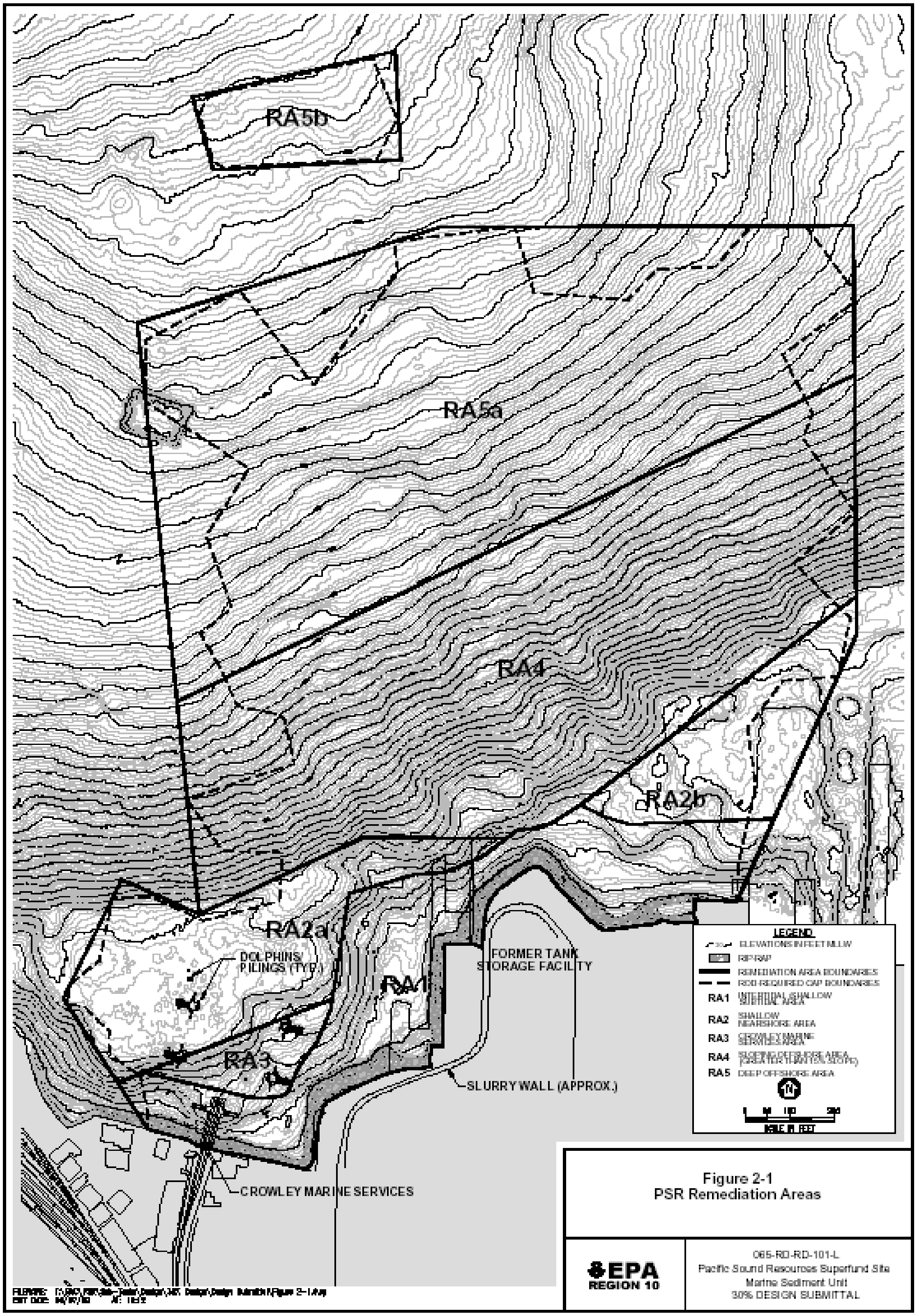

Figure 2 MSU Remediation Area 5a and 5b locations and extent

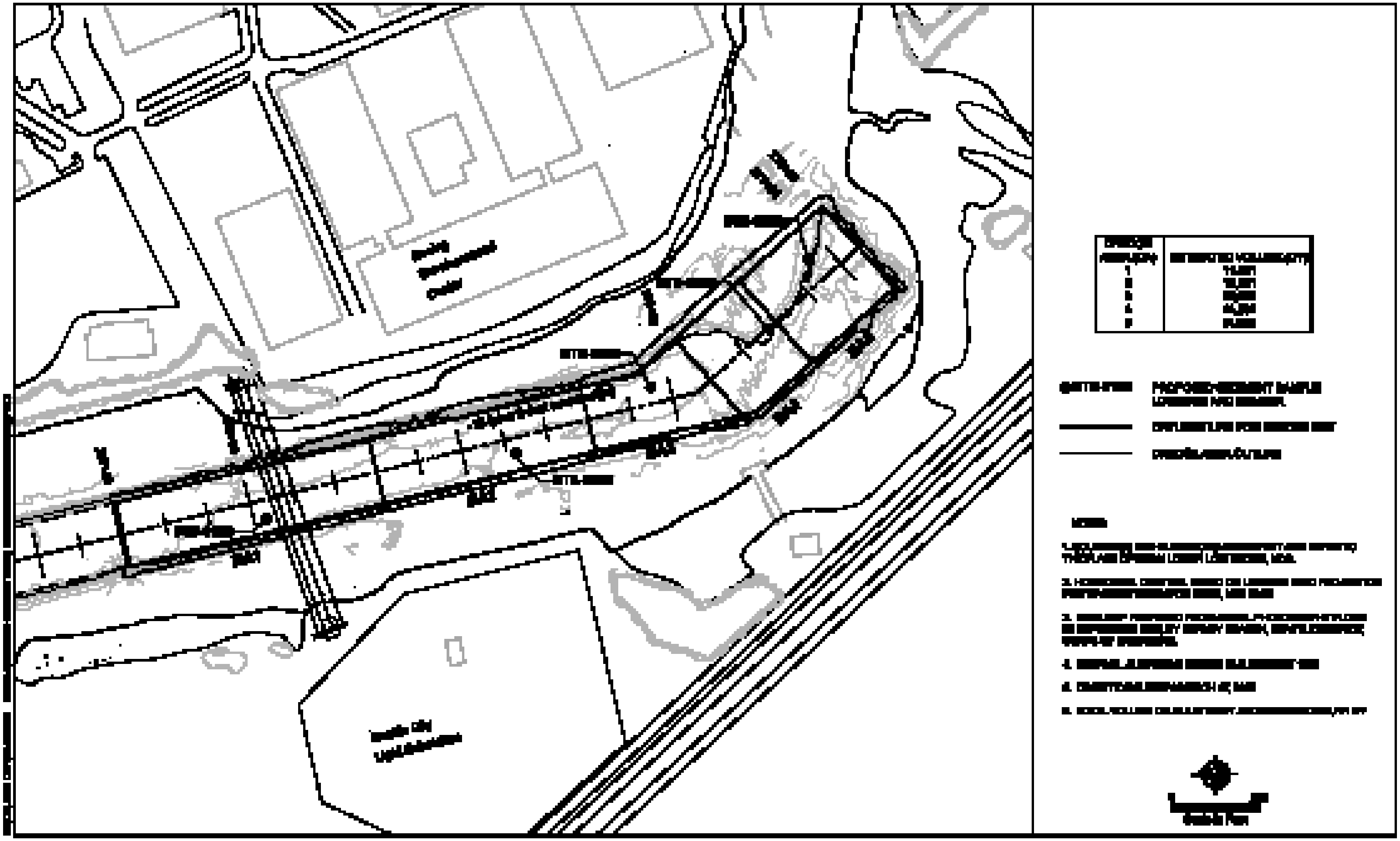

Figure 3 Proposed Dredging Area at the Turning Basin

1.3 Definition of Action Area

The action area, i.e., the area affected directly or indirectly by the dredging project, is defined as the Duwamish Waterway and Elliott Bay (Figure 1). The Duwamish Waterway begins at the confluence of the East and West Waterways of Harbor Island and extends upstream to the head of commercial navigation in the area known as the Turning Basin (River Mile 5.2) (Figure 1).

The shoreline along the Duwamish Waterway is intensively developed for industrial and commercial operations and the adjacent lands are similarly developed by a variety of water dependent industrial users. Beginning at the Turning Basin and continuing to the mouth, over-water structures (such as piers and docks) occupy 12,150 linear feet (2.3 miles) on both banks of the river. This represents about 20 percent of the lower estuarine shoreline (King County DNR 2001). As a major shipping route for containerized and bulk cargo, the navigation channel is subject to intense marine traffic, in addition to recreational boaters and other river users. The vast majority of the intertidal areas have been filled and developed, although several small intertidal restoration sites are located within the lower Duwamish River, including three restoration sites on the southern edge of the Turning Basin.

2.0 DESCRIPTION OF PROJECT AREA AND ACTION AREA

2.1 Historic Conditions

The lower Green/Duwamish River estuary was an area of very low gradient with a sinuous, meandering main channel. Most of the larger sediment had been deposited in the middle river, and the lower river had primarily sand and mud substrate. Most of the lower reach of the river was affected by tidal influence, whether freshwater tidal or brackish tidal. It is known that the river had several distributary channels spread over the broad delta floodplain. Large woody debris was carried into the lower river and estuary from the upper watershed during floods (Perkins 1993, USACE 1997a, 1997b).

The Duwamish Estuary was once a vast tidally influenced mosaic of swamp and marsh wetlands. The soils in this area were likely fine materials from alluvium mixed with organic materials from the vast amounts of plant material produced in the estuarine marshes. These soils are generally very deep, poorly drained, and subject to being compacted and destabilized when disturbed (Perkins 1993, USACE 1997a, 1997b).

The Duwamish delta at one time was over 4,000 acres of tidal and intertidal habitat (Bloomberg et al. 1988). There was likely a large and sustainable salmon and clam fishery in the Duwamish River and Elliott Bay available to Native Americans before Euro-American settlement.

Dredging of the mouth of the estuary and construction of Harbor Island by the City and Port of Seattle began in the early 1900's. Congress subsequently funded a navigation project for deepening, widening, and straightening of the estuary portion of the Duwamish River to facilitate the commercial navigation and industrial development that characterizes the lower river today. The consequence on the environment of these actions has been a substantial degradation of the entire ecosystem of the lower Duwamish River and estuary through a combination of levees, channelization, water source diversion dams, dams for flood control, and the destruction of the intertidal habitats in the estuary.

2.2 Current Conditions

Over the last 100 years, the braided flows of the lower river have been extensively channelized and reduced to a single permanent channel (the Duwamish Waterway) through dredging and construction of levees. Dredging has resulted in the replacement of 9.3 miles of meandering tidal channel habitat with the 5.2 miles of deep channel habitat that exists today (Bloomberg et al. 1988).

A natural rock weir, approximately one mile above the Turning Basin, retards saltwater intrusion into upriver areas, except during high tides and low stream flows, while freshwater inflows greater than 1,000 cubic feet per second (cfs) hold the saltwater wedge to areas downstream of

RM 7.8 regardless of tidal height (Stoner 1967). A general increase in the distance of saltwater intrusions inland has been documented and is largely attributed to the loss of freshwater flows (from the diversion of the White, Black, and Cedar Rivers) coupled with the regular deeping and channelization that comes with navigation dredging (USACE 1997a).

Nearly all intertidal wetlands and shallow subtidal aquatic habitats in the vicinity of Elliott Bay and the lower Duwamish River have been eliminated as a result of urban and industrial development; only about 1 percent of estimated 4,000 acres of tidal and intertidal habitat remains today. In addition to patches of remnant native marsh, a series of ten small intertidal marsh restoration projects have been constructed downstream of the Turning Basin since 1995. The existing shoreline banks are thin bands of mud- and sandflats along the toe of riprap. There are two pocket beaches at the head of the West and Main Slips along the shoreline of the PSR Superfund site that contain limited shallow subtidal aquatic habitats.

The lower end of the River (downstream of the Turning Basin) is the heavily industrialized portion known as the Duwamish Waterway (Figure 1). The shoreline along the Duwamish Waterway is developed for industrial and commercial operations and the upland areas are heavily industrialized. The Duwamish River segment of the larger Green/Duwamish River (RM 11 to 0) similarly contains intense industrial, commercial and residential development. The main navigation channel is a major shipping route for containerized and bulk cargo with intense marine traffic.

The alternative disposal sites (PSR Superfund site and the PSDDA open water site) lie within Elliott Bay, near the center of Puget Sound Basin (Figure 1). The geomorphology of the Puget Sound Basin has been shaped by several episodes of Pleistocene glaciations, which have resulted in a westward-sloping, gently rolling drift plain cut by many wide, steep-sided troughs.

The Elliott Bay shoreline has been extensively developed for urban, port, and industrial land uses; the area surrounding the disposal sites are principally used for water-dependant industries. The mouth of the Duwamish River’s West Waterway is located approximately 0.3 mile east of the PSR-MSU site and approximately one mile south of the PSSDA open water site (Figure 2).

The PSR-MSU site encompasses approximately 66 acres of Elliott Bay (Figure 1). Bottom depths within the MSU range from intertidal to over 200 feet deep, with a steeply sloped configuration from 6 to 20 (or greater) percent slope. The steepest slopes are nearshore, and slopes gradually decrease with increasing distance offshore. Tidal elevations range from extreme low water at –4 feet mean lower low water (MLLW) to extreme high water at +14.8 MLLW. Remediation Areas 5a and 5b (which may be capped with the dredged material) extend from approximately –140 to –240 feet MLLW and include slopes with approximately 4 percent to 15 percent grades. Circulation within Elliott Bay is driven principally by tidal forces, modified somewhat by the effects of winds, salinity and temperature differentials.

The PSSDA site encompasses approximately 415 acres of Elliott Bay (Figure 1). Bottom depths within the PSSDA site range from 300 to 360 feet deep. The circular disposal zone for release of the dredged material is 1,800 feet in diameter; included within this zone is the circular disposal target area that is 1,200 feet in diameter. Overall, the disposal site is approximately 6,200 feet by 4,000 feet in size.

3.0 DESCRIPTION OF PROPOSED ACTIONS

3.1 Dredging

Dredging would be accomplished using clamshell equipment, loading the dredged materials onto a bottom-dump barge. 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 operation, 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 clamp grabs a section of the sediments. As it is hoisted up through the water column, the jaws close carrying sediments to the surface. The sediments are then placed on a bottom-dump barge for transport to the disposal site.

The Turning Basin was last dredged in 2002 using a 5 cubic yard clamshell dredge and one 1,990 cubic yard capacity bottom-dump barge. That operation removed approximately 96,523 cubic yards of sediment, with an average of 3,700 cubic yards removed per day. Working 24 hours a day, six days a week, the dredging operation was accomplished between January 14 and February 9, 2002.

While the specifics of daily total loads, total days worked, and exact daily schedule are generally decided by the contractor at the time of dredging, the Corps anticipates that the FY 2004 and 2005 dredging will be conducted in a manner similar to the 2002 dredging. The FY 2004 and 2005 dredging and disposal activities will be performed between October 1 and February 14 of each fiscal year and will generally last approximately two to three weeks.

Based on a channel condition survey of March 2003, the proposed FY 2004 dredging operations are expected to remove approximately 65,100 cubic yards of river sediment between stations 257+00 and 275+56 (approximately 2,100 linear feet of channel) in the portion of the Waterway known as the Turning Basin (River Mile 5.2) (Figure 1). The navigable portion of the channel is 150 feet, widening at the 'turn' to approximately 250 feet (Figure 3). The 150-foot wide portion of the channel to be dredged is centered within the river, and thus retains the intertidal areas along both banks during and after dredging (Figure 3). The required dredge elevation is –15 feet MLLW, with an allowable over-depth of two feet below the required dredge depth (i.e. to –17 feet MLLW). The volume of this over-depth has been included in the approximately 65,100 cubic yard estimate of the total dredged volume. Side slopes along the edge of the dredged portion of the channel would be approximately 2:1 slopes 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 during FY 2005. Shoaling rates and depths depend on seasonal rainfalls driving river flows and sedimentation rates. However, the volume dredged in FY2005 would be conducted in the same manner, within the same time window, and with the same conservation measures (as described in Section 6.1.5) as the FY 2004 dredging and would be less than the permitted maximum of 200,000 cubic yards. Therefore, we expect similar effects to listed species during FY 2005 dredging (see Sections 5.0 and 6.0).

3.2 Disposal

3.2.1 Sediment Sampling

The portion of the channel to be dredged is considered a ‘low ranked’ area for contaminates. When this material was tested in accordance with the Dredged Material Management Office’s PSSDA protocols in 1998-1999, the Dredged Material Management Plan Agencies concluded that all the material was suitable for placement at the Elliott Bay PSSDA open water disposal site. The Corps Dredged Material Management Office sampled sediments from within the proposed dredging areas (Figure 3) according to the PSSDA protocols on June 26, 2003; these samples will subsequently be tested to determine whether the sediment meets the standards for disposal at the PSSDA site, as well as the Washington State Department of Ecology’s Sediment Management Standards (SMS) and Atterberg Limits for use as capping material. The sediment characterizations from the June 26, 2003 sampling have a ‘recency frequency’ of five to seven years; contaminate testing prior to dredging will be required again in 2008 or 2010.

If the sediment samples meet both of these standards, dredged material from the Turning Basin would be used as capping material for Remediation Areas 5a and 5b of the Marine Sediments Unit (MSU) within the PSR Superfund Site (Figures 1 and 2). If the sediment is unacceptable for use as capping material, but meets the standards for PSSDA disposal, the dredged sediment would then be disposed of at the WDNR-managed PSDDA open water, non-dispersive site in Elliott Bay (Figure 1). If samples from any individual dredge area were found unsuitable for unconfined open water disposal at the PSSDA site, the sediment from within that dredging area would not be dredged under this proposed action. The future disposal of any such sediment would be addressed as a separate action and a separate BA would be prepared.

Disposal activities will be conducted in accordance with established criteria for either the PSR Superfund or the PSSDA sites. Effects of the disposal actions are analyzed in their respective Biological Assessments previously prepared by the Corps, and have been accepted by NOAA Fisheries and USFWS as described in their respective concurrence letters (USACE 2000b and 2000c, USFWS 2000, NMFS 2000, USACE and EPA 2002, USFWS 2003, NMFS 2003a, NMFS 2003b). Therefore, the following sections of this BA present only a summary of the disposal actions and the effects described in those documents.

3.2.2 PSR Superfund Site and Marine Sediments Unit Cap

The Pacific Sound Resources Superfund site, and it’s Marine Sediment Unit (MSU) is located approximately 0.3 miles west of the mouth of the Duwamish River’s West Waterway (Figures 1 and 2). The site includes the area where the Wyckoff West Seattle Wood Treating facility existed, and contaminated the sediments in adjacent portions of Elliott Bay. The PSR site was listed on the Superfund National Priorities List in May 1994.

The marine sediment cap is designed to do the following:

- Reduce the chemical flux from contaminated sediments and groundwater, and chemically isolate these sources from benthic organisms;
- Physically isolate the contaminated sediments and provide a clean habitat for benthic organisms;
- Maintain stability under static loads and have an acceptable reliability under design seismic loads;
- Resist erosion, suspension and transport of cap materials and underlying contaminated sediments by waves, tidal and wind induced currents, and propeller wash.

Confinement of contaminated marine sediments is accomplished by placement of a sediment cap that covers approximately 58 acres, approximately 22 acres of which is associated with Remediation Area 5 – Deep Offshore Area, sub-areas RA5a and RA5b (Figure 2). These areas extend from approximately -140 to -240 feet MLLW and include slopes with approximately 4 percent to 15 percent grades. Placement of cap material in RA5 can be accomplished in the most cost-effective manner by instantaneous bottom-dump placement of dredged material originating from routine maintenance dredging projects in local rivers.

The cap design, including cap thickness and material specifications, will be completed in accordance with the Guidance for In Situ Subaqueous Capping of Contaminated Sediments (EPA 905-B96-004). Capping material will be selected and placed in such a way as to provide appropriate habitat for the marine organisms natural to the area. The entire area that is capped will be designated a “no-anchor” zone, to prevent damage by commercial vessels using large “whale-tail”-type anchors. Dredging restrictions will be placed on any future work within the PSR-MSU site.

4.0 SPECIES AND HABITAT INFORMATION

This section describes the listed species considered in this BA and the habitat indicators important for their survival and recovery. Estuarine and marine habitats are emphasized, because of the potential effects of the proposed dredging and disposal actions on those types of habitat. This evaluation is loosely based on the types of guidelines developed by NOAA Fisheries 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 1999). However, as these tools were developed for freshwater environments, they are not directly applicable to estuarine or marine 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

USFWS responded to our request for a list of species potentially affected by continued maintenance dredging and disposal activities in the lower Duwamish River with a species list on October 20, 1999. That list was used in the process of preparing the September 2000 BA for maintenance dredging (USACE 2000a).

Based on that list, other Duwamish Waterway projects, and on generally available information on the distribution of listed, proposed, and candidate species known to occur in the project area, the following species under the jurisdiction of USFWS are included in this BA:

Common Name	*Scientific Name*	Federal Listing Status	Critical Habitat Designated?
Bald Eagle	*Haliaeetus leucocephalus*	Threatened – July 12, 1995 Delisting proposed - July 6, 1999	No
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened – October 1, 1992	Yes May 24, 1996
Bull Trout	*Salvelinus confluentus*	Threatened – November 1, 1999	No

As noted previously, NOAA Fisheries has already concurred with effect determinations related to maintenance dredging in the Duwamish Waterway (NMFS 2001) through fiscal year 2005 for species under their jurisdiction, as presented in the Biological Assessment prepared for Fiscal Year 2001-2005 Maintenance Dredging, Upper Duwamish Waterway (USACE 2000a). NOAA Fisheries has also concurred with Essential Fish Habitat consultation for the PSDDA open water disposal site (NMFS 2003b). USFWS also concurred with the effect determinations made in that BA, but did not extend concurrence past February 15, 2002 (USFWS 2001). Consequently, this BA focuses on only those species under the jurisdiction of USFWS in evaluating the effects of fiscal years 2004-2005 routine maintenance dredging in the Duwamish Waterway.

4.2 Baseline or 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 effect fish populations (such as bull trout), they can also affect higher order consumers that feed on fish, such as bald eagles and marbled murrelets.

As a result of its commercial importance and highly degraded condition, the waterway has been the subject of numerous studies by various governmental and private entities. These studies have included water and sediment chemistry, physical habitat conditions, benthic community analyses, fish and marine invertebrate data, tissue chemistry, and toxicity bioassays. Due to the highly urbanized and degraded condition of the action area (i.e., a heavily industrialized waterway with a history of channelization, dredging, and intertidal filling) all of the baseline indicators can be considered ‘at risk’ or ‘not properly functioning’.

Many of these data are readily available in electronic format from the Sediment Quality System database (SEDQUAL), and the Dredge Analysis Information System database (DAIS). The degree of water and sediment contamination in the action area has resulted in a Consent Order between the EPA and the Washington State Department of Ecology as regulatory agencies, and the Port of Seattle, King County, City of Seattle, and the Boeing Company concerning the preparation of a river-wide Remedial Investigation and Feasibility Study for the Duwamish Waterway.

4.2.1 Water Quality

4.2.1.1 Water contamination

The Washington State Department of Ecology is responsible for setting water quality standards based on water use and water quality criteria. The five water quality classes are:

- AA: extraordinary
- A: excellent
- B: good
- C: fair
- Lake

The waters of Elliott Bay east of a line from Pier 91 to Duwamish Head are classified as Class A (very good) by state standards. The waters of the Duwamish River (River Mile 11 to 0) are designated Class B waters. Water quality within the lower Duwamish River can influence water quality conditions in the vicinity of both disposal sites due to their proximity to the Duwamish River estuary. Pollutants within the Duwamish River are derived primarily from industrial point and non-point sources, storm water runoff, discharges from vessels, and resuspension of contaminated bottom sediments.

Overall, water quality in the estuary was probably poorest in the early 1960s. Since then, enforcement of the Clean Water Act and subsequent State water quality standards and implementation of the National Pollutant Discharge Elimination System (NPDES) have spurred substantial improvement in water quality conditions in the Duwamish estuary. Diversion of wastewater effluent to Puget Sound has significantly reduced the biological oxygen demand in the estuary. Of the parameters for which historic data are available, all contaminants have been controlled to the point where few exceedances of state chronic water quality criteria, or thresholds for effects on salmonids, have been reported in recent years. Since the mid-1980s, there have been no reports of direct mortality of salmon or other fish in the estuary; problems previously associated with delayed chinook upstream migrations due to low dissolved oxygen barriers likewise have not been reported since the diversion of the Renton Treatment Plant outfall.

Elliott Bay and the Duwamish Waterway remain on the Department of Ecology's 303(d) list of threatened and impaired waters. The enforcement of total maximum daily load limitations for a number of parameters is expected to result in additional improvements in water quality. The trend for water quality in the Action Area is one of overall improvement.

4.2.1.2 Turbidity

The primary source of suspended sediment in Elliott Bay is the Duwamish River, generally consisting of fine-grained material. The presence of sand and shell debris in deeper sediments in the western portion of Elliott Bay suggests the role of sediment displacement from Duwamish Head into the Bay. The many bulkheads and piers along the Duwamish River and adjacent Elliott Bay shorelines reduce the transport of fine sediments and generally cause a sediment-starved condition throughout the action area.

The highest sources of turbidity at the potential disposal sites and within the Turning Basin are the periodic pulses of sediment moving downstream within the Duwamish River from seasonal rainfall events. Temporary pulses can also result from prop-wash from adjacent marine facilities and barge traffic.

We reviewed water quality sampling gauge data from the U.S. Geological Survey gauge located at the Foster Golf Links golf course in Tukwila Washington (Station No. 12113390) for the period since September 1995. This data indicates that the Duwamish River reaches its maximum suspended sediment levels generally between December and March. Average suspended sediment levels recorded during the window of the proposed dredging (October 1 through February 14) have been 72 mg/L, including the highest readings of 787 mg/L on February 9, 1996, 361 mg/L on February 12, 1996 and 196 mg/L recorded on January 3, 1997. Lowest readings during the proposed dredging period have been 4 mg/L in November and December 2000 and 7 mg/L in October 1996.

The Duwamish is also characterized by occasional high levels of suspended sediment occurring during the late spring and even well into the driest portions of the year (274 mg/L on March 19, 1997, 264 mg/L on August 7, 1997, 101 mg/L on March 22, 1998), likely due to intense precipitation from seasonal storm events.

4.2.1.3 Dissolved Oxygen

Elliott Bay appears to show a pattern of vertical stratification typical of similar bays in Puget Sound. Colder, denser marine waters typically move into shallow bays under certain tidal or current conditions and then stagnate for a certain period (dependent upon conditions in the bay) until another water mass moves in. During these stagnation periods, dissolved oxygen typically decreases at rates dependent upon sediment oxygen demand, temperature, fresh water influx, and other conditions. Although the Department of Ecology does not identify this area as being a persistently stratified estuary, it is likely that the area does experience decreased dissolved oxygen with depth and during the summer months.

The potential disposal sites are expected to typify these conditions to a greater extent than the Turning Basin dredging site, but any number of controlled or uncontrolled discharges may exacerbate water quality conditions within the Duwamish River and out into the nearshore environment of Elliott Bay. However, because vertical stratification and potential periods of low dissolved oxygen are to some extent natural conditions in this bay and estuary, local fish populations are presumably adapted to avoid areas of seasonally low dissolved oxygen conditions.

4.2.1.4 Temperature

In the lower Duwamish, the relative temperatures of the freshwater inflow and the saltwater intruded from Elliott Bay primarily influence water temperature (Warner and Fritz 1995). This saltwater intrusion profoundly influences water temperature at various depths in the Turning Basin (Muckleshoot Indian Tribe Fisheries Department, unpublished data). For example, in January, water temperatures measured at 1-meter depths can increase from 36.5 to 46.8°F over a depth of 8 meters (26.2 feet). In May, temperature measured at 1-meter (3.3 feet) depths can decrease from 63.9 to 52.9°F measured over a total depth of 4 meters (13.1 feet). In September, temperatures are more uniform decreasing from 61.9 to 56.8°F. The range of temperatures over depth is also influenced by the tidal stage. The variation in water temperature with depth provides adult and juvenile salmonids some refuge from the higher temperatures. However, in the late summer and early fall, the general range of temperatures offers no refuge from temperatures considered outside the preferred range for sensitive salmonid species.

Lack of large vegetation in the riparian zone has also been cited as a significant cause of elevated temperature. Due to the heavy industrialization, there is a near complete lack of riparian trees along the shoreline of the lower Duwamish River. Thus, the contribution of vegetation as an effective buffer against increasing water temperature from direct sun exposure is probably minimal for the action area and the lower Duwamish River on the whole.

4.2.2 Physical Habitat Quality

4.2.2.1 Sediment contamination

There is a high degree of sediment contamination currently found within the PSR Superfund Site and the intertidal and subtidal habitats of the Marine Sediment Unit. The contamination is the result of relatively recent anthropogenic sources principally the Wyckoff West Seattle Wood-Treating Facility in operation from 1909 until 1994. Sediments in the PSR-MSU are contaminated with polycyclic aromatic hydrocarbons (PAH) and other hazardous substances; contaminant levels far exceed sediment quality standards. Current remediation efforts intended to minimize human and benthic community exposure to contaminants, as well as the potential effects of these efforts on Federally listed fish and wildlife species are detailed in the Biological Assessment previously prepared for the PSR Superfund Site and the MSU (USACE and EPA 2002).

The Environmental Protection Agency (EPA) is evaluating the sampling record within the lower Duwamish River, including the proposed dredging at the Turning Basin, for designation as a Superfund site on the National Priorities List due to sediment contamination. Sediment sampling within the portion of the Duwamish River below the proposed dredging area (i.e. below station 254+00) has identified several contaminates of concern, including oil and grease, sulfides, pesticides, polychlorinated biphenyls (PCBs), and polyaromatic hydrocarbons (PAHs) (USACE 1995, 2000d). Urban and industrial development in the lower Green/Duwamish River has resulted in numerous sources of contamination, including industrial discharges, combined sewer overflows, stormwater runoff, and shipping-related sources (i.e. accidental spills, treated pilings) (TetraTech 1998).

The sediments for the FY 2004-2005 segment (between Stations 257+00 and 275+56) were tested according to Puget Sound Dredged Disposal Analysis (PSDDA) protocol and the results will be presented in a project-specific environmental assessment and Clean Water Act Section 404(b)(1) evaluation. This sampling was conducted on June 26, 2003 and the results are anticipated within a few months of the sampling. Those results will determine the options for disposal of the sediment dredged from the navigation channel, including either beneficial use of the dredged sediments for capping the MSU or disposed at the PSDDA open water site in Elliott Bay, as discussed throughout this BA.

4.2.2.2 Shoreline and Estuarine Habitat Conditions

The shorelines of Elliott Bay and the lower Duwamish River (as well as the adjacent shorelines of Puget Sound) are almost exclusively armored (rip rapped). The existing shoreline banks are thin bands of mud- and sand-flats along the toe of the rip rap. Common shoreline features also include constructed bulkheads and piers, principally for large commercial and industrial marine users. Similarly, nearly all intertidal wetlands and shallow subtidal aquatic habitats in the vicinity of Elliott Bay and the lower Duwamish River have been eliminated as a result of urban and industrial development.

Filling, dredging, and armoring have also diminished the extent and function of intertidal habitats around the PSR Superfund site and the Marine Sediment Unit. There are two pocket beaches at the head of the West and Main Slips along the shoreline of the PSR Superfund site that contain limited shallow subtidal aquatic habitats. There are no intertidal habitats present near the PSSDA open water disposal site due to water depths in that area.

4.2.2.3 Disturbance/Noise

Due to the highly industrialized nature of Elliott Bay and the lower Duwamish River, these areas are subject to frequent and intense marine traffic, and the consequent noise and disturbance associated with the commercial and industrial facilities along the shoreline. In addition to recreational vessels of all types and sizes, these areas are subject to ocean-going container ships, oil tankers, tugboats, barges, Washington State ferries, Coast Guard vessels, military vessels, and most recently, international cruise ships. Consequently, existing noise and disturbance levels are typical of highly industrialized areas.

4.2.3 Biological Habitat Quality

4.2.3.1 Biological Resources

Biota utilizing habitats within the action area (the potential disposal sites in Elliott Bay and the lower Duwamish River) include a variety of marine and aquatic invertebrates, estuarine and marine fish and shellfish, anadromous salmonids, birds, and marine mammals.

Invertebrates

Common marine invertebrates on the piling surfaces, riprap, and bulkhead areas of the Marine Sediment Unit include barnacles, tube-dwelling worms, sea anemones, sponges, tunicates, and mussels. Marine invertebrates documented or anticipated to utilize the offshore subtidal habitat of the MSU include a variety of polychaetes, clams, mussels, crabs, and shrimp. The benthic infauna at the PSDDA open water disposal site is dominated by large polychaetes and bivalve mollusks. Polychaetes make up 51 percent, mollusks 39 percent, and crustaceans only 4 percent of the biomass (USACE 2000c). Other common invertebrates occurring in Elliott Bay include anemones, various shrimp, nudibranches, sponges, and sea cucumbers. Barnacles, bay mussels, limpets, and snails are typical invertebrates found on rocky or other hard intertidal substrata.

A number of studies have characterized the benthic community on the mudflats and remaining remnant marshes in the Duwamish River estuary. Many of these studies have been undertaken in conjunction with the Elliott Bay/Duwamish Restoration Program and have been conducted by the USFWS and the University of Washington, Wetland Ecosystem Team (Low and Myers 2002). These studies illustrate the importance of the estuarine environment in providing food for juvenile salmonids. Juvenile salmonids prey preferentially on certain species of tiny crustaceans including amphipods (e.g.,*Corophium* spp., *Anisogammarus, Eogammarus*), some species of harpacticoid copepods (e.g., *Harpacticus uniremis*, *Tisbe* sp.), cumaceans, opossum shrimp, and midges (Chironomidae larvae).

Anadromous Salmonids

Multiple migratory runs of both native and hatchery reared salmonid stocks occur seasonally in Elliott Bay and the Duwamish River (Warner and Fritz 1995). The use of Elliott Bay by salmonids is believed to be predominantly as a migration corridor. However, some rearing and foraging by juvenile salmonids is likely, particularly in the limited shoreline areas with some structural diversity. Juvenile chinook, chum, and pink salmon have been observed in varying abundance and within 0.5 km of the Marine Sediment Unit site (Weitkamp and Schadt 1982).

Returning adult salmon congregate at the mouth of the Duwamish River in the vicinity of the Marine Sediment Unit prior to upstream migration, and juvenile salmonids may use the nearshore reaches of the MSU to transition into marine waters. In-migrating adult salmon use deeper areas of Elliott Bay prior to moving into the Duwamish River.

The Green/Duwamish River system supports a diversity of salmonid species compared to other rivers of this size in the Puget Sound region. There are nine species of anadromous salmonids that have been documented in the Green/Duwamish River: summer/fall chinook salmon, fall run coho salmon, fall run chum salmon, cutthroat, sockeye, and summer/winter steelhead trout, and native char (recently broken into two species - dolly varden (*Salvelinus malma*) and bull trout (*Salvelinus confluentus*). Pink salmon are present in the system, but no longer in large numbers, perhaps due to the dramatic loss of estuarine and intertidal habitats in the lower Duwamish River. Chinook, chum, and coho, and steelhead trout utilize Elliott bay to access upstream freshwater spawning habitat associated with the Duwamish and Green rivers. Chinook and chum utilize Elliott Bay and the Duwamish estuary more extensively than other anadromous species (Weitkamp and Schadt 1982; Meyer et al. 1981), especially when congregating at the mouth of the Duwamish River (vicinity of the MSU) during their adult return.

The principal juvenile salmonid out-migration season occurs from mid-April through mid-June for steelhead, coastal cutthroat, coho, and chinook; chum salmon generally out-migrate slightly earlier, between mid-March and early May (Grette and Salo 1986, USACE 1998). NOAA Fisheries concurred with the determination of ‘may affect, but is not likely to adversely affect’ Puget Sound chinook salmon or its critical habitat for the proposed FY 2001-2005 dredging and disposal activities at the Turning Basin (USACE 2000a, NMFS 2001).

In the last 50 years, no juvenile bull trout have been reported in the Green River basin, although adult bull trout have sporadically been captured in the Duwamish River estuary and lower Green River (Matsuda et al. 1968, Grette and Salo 1986, Warner and Fritz 1995). Recently, sub-adult bull trout have been captured in Newakum Creek in 2000 and at the Turning Basin in August and September 2000, September 2002, and most recently in May 2003 (J. Chan USFWS unpublished data, Jim Shannon, Taylor and Associates, unpublished data). As a federally threatened species, the occurrence and potential effects of the proposed dredging and disposal activities on bull trout is addressed in detail in Section 6.2.

Birds

Bald eagles are occasionally seen over the MSU and the PSSDA open water disposal site, and are fairly frequently seen perching or foraging along the lower Duwamish River. Eagle nests occur within four miles of the dredging site and within one to two miles of the disposal sites. As a federally threatened species, the occurrence and potential effects of the proposed dredging and disposal activities on bald eagles are addressed in detail in Section 6.2. Similarly, the marbled murrelet is a permanent, though not common resident of southern Puget Sound in the vicinity of the disposal sites and the lower Duwamish River. In the Pacific Northwest, it forages almost exclusively in the nearshore marine environment (mainly within a few miles of shore), but nests 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 waters of Elliott Bay, particularly during the winter. As a federally threatened species, the occurrence and potential effects of the proposed dredging and disposal activities on marbled murrelets are addressed in detail in Section 6.3.

The shorelines of and the waters overlying the Marine Sediment Unit provide habitat to a number of terrestrial and water dependent birds that may serve as prey for bald eagles. These species include loons, grebes, cormorants, scaups, mergansers, coots, and gulls. The majority of these birds utilize the water column habitat in the vicinity of the MSU during their respective over wintering periods. These over wintering waterfowl species are generally found in the central Puget Sound region from early November through late April, with the highest concentrations during December through February. The remaining waterfowl are present year-round. Most of the year-round and over wintering species are classified as “divers” and actively pursue pelagic and benthic organisms up to 10 meters or more below the water surface.

Similarly, abundant waterfowl species within the lower Duwamish River also provides an avian prey base for bald eagles. Common species include greater scaups, ring-necked ducks, scoters, American wigeons, Canada geese, mallards, common goldeneye, mergansers, and bufflehead. Other common species include western grebes, double-crested cormorants, American coots, pigeon guillemots, and several gull species. Shorebirds observed in the vicinity of the Duwamish waterway have included sandpipers, dunlins, and snipe. These waders are generally present in the tidal mudflats and marshes or along sandy shorelines.

Several other bird species expected to 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 fairly frequently within the action area and have been observed near the disposal sites and within the lower Duwamish River.

Since 1994, a pair of peregrine falcons has been nesting seven miles to the east of the MSU and the PSSDA sites in downtown Seattle, atop the east side of the Washington Mutual Tower. While this pair has not been active at the Washington Mutual site in 2003, the female may be nesting about four blocks away at One Union Square and the male may be nesting with other females either in West Seattle. Peregrine falcons were also reported using a nest box under the West Seattle Bridge just south of Harbor Island in 1999 (Priority Habitat and Species database search June 5, 2003). Peregrine falcons would be expected to hunt waterfowl over Elliott Bay and the disposal sites, and to hunt waterfowl and pigeons over the lower Duwamish River and shoreline industrial facilities.

Osprey are frequently seen foraging for fish over Elliott Bay and the lower Duwamish River and appear to be fairly tolerant of human disturbance when choosing nesting locations. Since 1999, osprey nests have been documented on utility poles or other man-made structures in at least three locations within five miles of the proposed dredging: on the east side of the Turning Basin, at Terminal 105 (Crowley Marine facility), and at Terminal 18 on Harbor Island (Priority Habitat and Species database search June 5, 2003).

Similarly, great blue herons are also frequently seen wading within the lower Duwamish River and its remaining intertidal habitats. Bald eagles are known to disrupt rookeries while attempting to prey upon young herons. Three heron rookeries have been documented within the action area: approximately four miles downstream of the Turning Basin on the forested slope west of Terminal 105 (nests unoccupied in 2000), the Black River rookery approximately four miles southeast has been active since 1985, and the Seahurst park rookery has been active since 1981 approximately 3.5 miles southwest of the Turning Basin (Priority Habitat and Species database search June 5, 2003).

A purple martin nest was noted in 1979 within the Bon Marche parking garage in downtown Seattle, approximately seven miles east of the proposed disposal sites (Priority Habitat and Species database search June 5, 2003). In recent years, private individuals have erected nest boxes around Puget Sound and the lower Duwamish River and these boxes have successfully attracted nesting purple martins. As of June 2003, ten pairs are nesting in Jack Block Park on the west side of Harbor Island, a pair is nesting at Kellogg Island, and one to two pairs are nesting at Terminal 105. There are currently no nest boxes erected further upstream (i.e. toward the Turning Basin dredging site) than the Terminal 105 site (Kevin Lee, personal communication, June 9, 2003).

The horned grebe and red-necked grebe (State Monitor species), as well as the western grebe, Brandt's cormorant, merlin, and common murre (State Candidate species) and the common loon (State Sensitive species) are also likely to forage over or utilize surface waters associated with the MSU.

Marine Mammals

Harbor seals and Dall's porpoise are known to frequently forage in Elliott Bay and are both State Monitor Species (Calambokidas 1991). Harbor seals are also common within the lower Duwamish River where they forage for fish. Similarly, orca whales and Pacific harbor porpoise are also common within Elliott Bay and are both State Candidate Species (Calambokidas 1991). California gray whales, Pacific harbor porpoise, and California sea lions are also common inhabitants of the action area. Harbor porpoise and harbor seals are year-round residents. California sea lions may utilize waters of Elliott Bay in the winter to feed on migrating salmon

and steelhead trout (Pfeifer 1991). Both harbor seals and California sea lions have been seen hauled out on floats and navigation buoys moored within the Marine Sediment Unit.
Stellar sea lion and humpback whale are the only marine mammal species potentially within the action area that are federally proposed or listed as threatened or endangered species. NOAA Fisheries has concurred with the determination of 'may affect, but is not likely to adversely affect' the humpback whale and the Stellar sea lion for the proposed FY 2001-2005 dredging and disposal activities at the Turning Basin (USACE 2000a, NMFS 2001).

4.2.3.2 Benthic and Epibenthic Prey Availability

Benthic and epibenthic invertebrate prey assemblages have been documented in the lower Duwamish River since 1994 as part of the Duwamish River Coastal America restoration program and subsequent restoration efforts undertaken by USFWS and the Elliott Bay/Duwamish Restoration Program. These restoration efforts have been designed to recreate intertidal marsh vegetation along the lower Duwamish and in so doing, provide critical habitat for juvenile salmonids to forage on benthic and epibenthic invertebrates. These studies have documented a diverse assemblage of invertebrates, with variable invertebrate biodiversity (density and number of species) depending on the age and structure of the habitat (Cordell et al. 1994, 1996, 1997, 1999). While the intertidal marshes surrounding the Turning Basin have been studied and documented over the past nine years, benthic assemblages within the deeper and unvegetated dredged channel are not well documented, although are expected to be of much lower biodiversity than those of the adjacent intertidal marshes. Because of their occurrence at deeper depths, the assemblages within the center of the channel are also likely of lower functional value to juvenile salmonids.

EPA has demonstrated that important benthic and epibenthic prey assemblages exist within the PSR Superfund site and the Marine Sediment Unit, including species researchers have considered sensitive to pollution. However, sample areas that were associated with known contaminated sediments showed a distinctly different benthic community. The dominant species at the contaminated locations are all polychaete worms that are frequently associated with stressed habitats. EPA concluded that the presence of contaminated sediment in unremediated areas adversely affects the species diversity and abundance of benthic organisms and therefore affected the diversity and abundance of the prey resources available to migrating salmonids.

4.2.3.3 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 crustaceans and are themselves important prey items for larger juvenile salmon and for bull trout. Sand lance is particularly important for juvenile chinook and bull trout.

Within the action area, surf smelt spawning occurs on the northern shore near Alki Point, along Williams Point just north of Fauntleroy Cove, and along the Seahurst Park shoreline and Secoma Beach (WDFW PHS database search June 9, 2003, D. Pentilla Washington State Surf Smelt Fact Sheet undated). Documented Pacific sand lance spawning beaches occur in these same areas (D. Pentilla, Washington State Sand Lance Fact Sheet, undated) within Puget Sound. Pacific herring do not spawn within the action area, but do spawn within Quartermaster Harbor between Vashon and Maury Island and within Port Orchard and Port Madison bays along western and northern Whidbey Island, respectively (WDFW PHS database search June 9, 2003, D. Pentilla Washington State Pacific Herring Fact Sheet undated). None of these forage fish species spawn at the PSR-MSU or within the lower Duwamish River, likely due to the modified shoreline and lack of intertidal gravel and sandy beaches (WDFW PHS database search, June 9, 2003). Fish sampling conducted by USFWS in 2001 captured small numbers (less than ten individuals) of Pacific sandlance at both the Turning Basin and the Hamm Creek estuary restoration sites (Low and Myers 2002).

4.2.3.4 Intertidal Vegetation

The area of wetlands and more natural shorelines along the Duwamish estuary and Elliott Bay has increased modestly over the last few years through restoration efforts and as mitigation for redevelopment projects. A series of ten small intertidal marsh restorations have been constructed downstream of the Turning Basin since 1995 and represent nearly the only areas of native intertidal marsh within the lower Duwamish River. However, these areas of habitat are isolated (for terrestrial species) by intensive development between patches. The marshes are dominated by Lyngby's sedge (*Carex lyngbyei*), hard-stem bulrush (*Scirpus acutus*), and common cattail (*Typha latifolia*) with generally vegetated upland buffers that have also been planted as part of the restoration efforts. Agencies and non-profit groups including, but not limited to, the Port of Seattle, King County DNR, the City of Seattle, the COE, USFWS, and People for Puget Sound are actively monitoring and maintaining many of these areas.

These restored areas have been shown to receive substantial utilization by juvenile salmon including chinook, and to provide important benthic and epibenthic prey resources (e.g., Cordell et al. 1997, 1998). The restoration of these habitats is part of an overall trend toward improvement in the estuary that began with improvements in source control and water quality in the 1970s and continues today.

4.2.3.5 Riparian Vegetation

There are virtually no functional riparian communities along the lower Duwamish River, with the exception of Kellogg Island, located approximately three miles downstream of the Turning Basin. Scattered patches and individual trees are all that remains of the once diverse riparian forests and tidal swamps that fringed the lower Duwamish River (Bloomberg et al. 1988). Currently, dominant riparian species include black cottonwood (*Populus balsamifera*), Pacific willow (*Salix lucida*), Hooker's willow (*Salix hookeriana*), and red alder (*Alnus rubra*) trees, with understory shrubs dominated by invasive Himalayan blackberry (*Rubus discolor*) and evergreen blackberry (*Rubus laciniatus*) growing out of the riprapped shorelines.

5.0 EFFECTS OF THE ACTION

The effects of disposal of the dredged material at either the PSSDA open water disposal site or beneficial use of the dredged material for capping the Marine Sediment Unit of the PSR-Superfund site have been analyzed in detail in previous BA's (USACE and EPA 2002, USACE 2000b, USACE 2000c). Both USFWS and NOAA Fisheries have concurred with the effects determinations presented in those documents for potential effects from proposed disposal activities at both the PSDDA and the MSU sites (PSSDA site -USFWS 2000d, NMFS 2000, NMFS 2003b; MSU site –USFWS 2003, NMFS 2003a).

Consequently, this analysis focuses primarily on the short- and long-term, direct and indirect effects of routine maintenance dredging of the Turning Basin on Federally listed endangered or threatened species under the jurisdiction of USFWS. The proposed dredging will occur during Fiscal Years 2004 and 2005, between October 16 and February 14. Potential effects from disposal of the dredged material are addressed by reference to the above documents for the PSR Superfund site and the PSSDA open water disposal site.

Effect determinations were based on predicting changes from the baseline condition of the indicator-based categories of habitat function described in Section 3.0. 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. Specific effect determinations for bull trout, bald eagle, and marbled murrelet (Section 6.0) conclude this document.

5.1 Effects on Water Quality

5.1.1 Water contamination

The project is expected to result in short-term turbidity, limited to the area immediately adjacent to the dredging equipment. Sediment mobility data compiled for the 1999-2000 deepening of the East Waterway portion of the lower Duwamish River included elutriate analyses which are useful for assessing the potential for release of contaminants into the water column due to dredging operations. The elutriate test data indicated that none of the contaminants of concern in the East Waterway appeared at levels exceeding the Marine Acute Criteria threshold used for sediment determinations by the PSDDA program (USACE 1999).

The Washington Department of Ecology (WDOE) 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 proposed dredging for FY 2004 and 2005 has been granted a WDOE Water Quality Certification with accompanying conditions to reduce impacts to water quality during dredging (WDOE 2001). A Modification to the Water Quality Standards has also been granted. The modification specifies the following criteria to accommodate temporary impacts on water quality: a mixing zone of 300 feet radially and 600 feet down current from the dredging operation, waived Class A turbidity standards, and no reduction in dissolved oxygen below 4.0 mg/l. The WDOE Water Quality Certification also stipulates corrective measures if water quality parameters exceed established standards during dredging operations. These corrective measures emphasize the following: (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 WDOE 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.

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

5.1.2 Turbidity

Temporary increases in turbidity (as measured by suspended sediment concentration) are expected in the dredging and disposal areas. During dredging, 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 dredge. 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).

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.

However, in order to reduce potential negative effects of turbidity on juvenile salmonids, even of limited duration, dredging operations would be timed between October 1 and February 14 specifically to avoid juvenile out-migration periods. This timing will dramatically reduce the temporal overlap between anticipated increases in turbidity during dredging and the presence of juvenile salmonids within the lower Duwamish River, thereby reducing the potential for exposure of juveniles to harmful levels of turbidity to a negligible level.

The proposed dredging period also coincides with periods of naturally higher background turbidity due to high winter levels of precipitation and runoff. Average suspended sediment levels recorded during the window of the proposed dredging (October 1 through February 14) were 72 mg/L between 1995 and 2001. During the dredging, areas of increased turbidity over background levels are expected to last only for a short duration. Any early migrating juvenile salmonids or adults that may be transiting through the Turning Basin could hold in the adjacent intertidal marshes along the western shoreline until any areas of increased turbidity dissipates into background levels.

The above information indicates that turbidity (suspended solids) would be elevated on a temporary and localized basis by dredging, but that total suspended sediment levels sufficient to cause adverse effects on the species of concern would be very limited in extent and duration. Therefore, temporary increases in turbidity 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).

5.1.3 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 are possible 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. 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.

Adult fish are expected to avoid any localized areas of significantly depressed dissolved oxygen and utilize the adjacent, non-dredged edges of the channel for refuge during operation of the dredge. 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 Duwamish River. The resulting configuration of the bottom will not significantly change currents or flow pathways within the navigation channel. Dredging will remove areas of shoaled sediments and will return the Turning Basin portion of the navigation channel to its authorized depth. The dredging will similarly have no effect on the distribution or density of riparian vegetation fringing 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 regular testing of sediments within the proposed dredging area (Figure 3) 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. Sediment characterization and dredging in 1998 and 2002 indicated that all dredging areas between stations 257+00 and 275+56 were suitable for both beneficial uses and open water disposal.

The Corps Dredged Material Management Office has sampled sediments from within the proposed dredging areas according to the PSSDA protocols on June 26, 2003; subsequent testing will determine whether the sediment meets the standards for disposal at the PSSDA site, as well as the Washington State Department of Ecology's Sediment Management Standards (SMS) for use as capping material.

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). If the dredged material is used for capping the Marine Sediment Unit of the PSR Superfund site, the proposed project could in fact reduce the exposure and uptake of sediment contaminates from that area.

5.2.2 Shoreline and Estuarine Habitat Conditions

Maintenance dredging will not result in any deepening and/or widening of the project channel at the Turning Basin; dredging will only be conducted to maintain the authorized depths of the navigation channel (-15 feet plus up to 2 feet over-depth). 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). The dredging would not impact intertidal mudflats or restored areas of saltmarsh. Therefore, the proposed dredging is not expected to 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 at the Turning Basin 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 neighboring properties or adjacent habitats due to the short duration of their presence. Noise and activity during dredging operations could temporally 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.

Therefore, temporary increases in noise and disturbance during dredging are expected to be insignificant and discountable and are not expected to significantly degrade existing conditions within the action area or to have adverse effects on listed species (as detailed in Section 6.0).

5.3 Effects on Biologic Habitat Quality

5.3.1 Biological Resources

5.3.1.1 Fish

A clamshell dredge would be used for the proposed project. Due to the characteristics of this equipment, it is generally accepted that clamshell buckets do not have the potential to entrain fish because the bucket cannot trap or contain a mobile organism during its descent because it is totally open. Due to the 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 [unpublished data], 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 the dredging is confined to the center of the navigation channel, 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).

5.3.1.2 Birds

Resident populations of osprey, peregrine falcon, great blue heron, purple martin, and the variety of songbirds, shorebirds, and waterfowl that utilize the lower Duwamish River are believed to be acclimated to the levels of human disturbance, noise, and the existing, degraded habitats of the action area. Resident individuals wintering along the shore or within the restored areas of saltmarsh may avoid the center of the navigation channel during dredging, but this effect is expected to be temporary. Resident waterfowl and seabirds resting or foraging in Elliott Bay are also expected to avoid the immediate area of the disposal activities while the barges are being dumped. Resident birds are expected to immediately return to their usual foraging areas and behaviors after the dredging stops and thus the proposed action is not expected to reduce the foraging prey base for bald eagles (see Section 5.3.3). Seagulls and other more aggressive birds that regularly utilize the lower Duwamish River, such as crows and possibly osprey, may be attracted to the dredging area by any disoriented fish avoiding the water column surrounding the dredge.

The proposed dredging is thus expected to have insignificant and discountable effects on resident birds in the action area and is not expected have adverse effects on listed bird 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 along the center-line of the navigation channel. 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 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. Because the dredging will occur down the center of the navigation channel, 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.

Disposal of the dredged sediments will also eliminate deeper subtidal invertebrate communities at the disposal sites by smothering them. However, as with shallower benthic and epibenthic invertebrates within the navigation channel, recolonization from adjacent areas is expected within a relatively short timeframe (two to three years). Romberg et al. (1995), studying a subtidal sand cap placed to isolate contaminated sediments in Elliott Bay, identified 139 species of invertebrates five months after placement of the cap. The benthic community reached its peak population and biomass approximately two and one-half years after placement of the cap, and then decreased, while the number of species increased to 200 as long-lived species recruited to the population (Wilson and Romberg 1996).

If the dredged sediments are used to cap the contaminated sediments of the Marine Sediment Unit at the PSR Superfund site, the benthic invertebrate community in that area is expected to ultimately be restored through creation of cleaner benthic habitat. Thus, higher invertebrate diversity and abundance are expected in this area once exposure to contaminated sediments is reduced or eliminated through capping.

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 (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 could be entrained in the clamshell bucket during daytime dredging, but they are unlikely to be affected by dredge 'bites' that occur at night since these fish diurnally burrow into beaches at night.

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 vicinity of the dredging or disposal activities. 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 foodweb interactions (as detailed in Section 6.0).

5.3.4 Intertidal Vegetation

Because dredging activities are concentrated in the center of the navigation channel, the proposed dredging will not directly impact the intertidal marsh restorations at the Turning Basin. By maintaining the navigatable depth of the waterway at the Turning Basin, the proposed dredging will help prevent barges from stranding in this area (as they have in the past). Vessel stranding and salvage has the potential to cause catastrophic disturbance to the developing marsh.

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, the proposed dredging will not impact the scattered patches of trees and shrubs which fringe portions of the lower Duwamish 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 scattered areas of riparian vegetation within the action area.

5.4 Cumulative, Interrelated, and Interdependent Effects

The disposal of the dredged material generated by the dredging operations is an interrelated and interdependent effect of the proposed dredging. The effects of disposal of the dredged material at either the PSSDA open water disposal site or beneficial use of the dredged material for capping the Marine Sediment Unit of the PSR-Superfund site have been analyzed in detail in previous BA's (USACE and EPA 2002, USACE 2000b, USACE 2000c). Both USFWS and NOAA Fisheries have concurred with the effects determinations presented in those documents for potential effects from proposed disposal activities at both the PSDDA and the MSU sites (PSSDA site -USFWS 2000d, NMFS 2000, NMFS 2003b; MSU site –USFWS 2003, NMFS 2003a).

Other interrelated and interdependent effects of the proposed dredging include the continuation of deep-draft ships utilizing the Duwamish Waterway up to the Turning Basin. The proposed dredging safeguards navigation within the Waterway by removing potentially hazardous areas of shoaling and maintaining the authorized depth of the navigation channel. 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 Waterway.

Other projects with the greatest potential to have cumulative effects with the proposed maintenance dredging are other periodic maintenance dredging and disposal projects by the Port of Seattle in the Port-maintained piers. These projects are similar in frequency to the proposed dredging, occurring every few years or longer, but are generally smaller in scope, usually in specific small areas that have shoaled in since the last dredging. The cumulative effects of other maintenance dredging projects on the physical parameters of Elliott Bay and the lower Duwamish River are expected to be similar to those of those effects described above, if clamshell dredging is utilized. These cumulative effects are expected to be temporary, insignificant, and discountable. Similarly, the cumulative effects of these other maintenance dredging projects on bull trout, bald eagles, and marbled murrelets are also expected to be minimal.

Minimal effects are expected because all of these projects would likely occur outside the fish window of February 15 to July 15 (or as otherwise defined by NOAA Fisheries, USFWS, or WDFW), and so would largely avoid effects on juvenile salmonids. Cumulative effects would also be minimized on bald eagles and marbled murrelets by avoiding disturbance in and around local nests and by avoiding disruptions of the local prey base through appropriate timing of work windows. Therefore, there is very little potential for cumulative effects on bull trout, bald eagles, and marbled murrelets as a result of these multiple maintenance-dredging projects.

6.0 EFFECT DETERMINATIONS

6.1 Summary of Effect Determinations

Common Name	*Scientific Name*	*Effect on Listed Species*	*Effect on Designated Critical Habitat*
Bull Trout	*Salvelinus confluentus*	May affect, but is not likely to adversely affect	No critical habitat designated
Bald Eagle	*Haliaeetus leucocephalus*	May affect, but is not likely to adversely affect	No critical habitat designated
Marbled Murrelet	*Brachyramphus marmoratus*	May affect, but is not likely to adversely affect	No effect on designated critical habitat

6.2 Bull Trout – Coastal/Puget Sound Distinct Population Segment (DPS)

6.2.1 Description of Species

Bull trout (*Salvelinus confluentus*) are native char and are part of the salmonid family. Bull trout were historically found throughout the Pacific Northwest, from Northern California to the upper Yukon and Mackenzie drainages in Canada. Inland populations were found in Idaho, Montana, Utah, and Nevada. Bull trout may be extirpated in California, and have declined in numbers in much of their range, especially along its southern limits (McPhail and Baxter 1996); bull trout have probably been extirpated from parts of their former range in Washington, such as Lake Chelan and the Okanogan River. The USFWS issued the determination of threatened status in the federal register on November 1, 1999 (FR 64 [210]: 58910-58933).

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° Fahrenheit, while temperatures less than 40° Fahrenheit 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).

6.2.1.1 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 Commencement Bay 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, and occasionally use or cross deeper waters to access locations along the westside of the Sound. It is unknown if individuals from Puget Sound populations migrate as far west as the Straits of Juan de Fuca, and to what extent they may migrate up the coast of British Columbia.

Bull trout may also use the estuaries and reaches of river systems that have not historically or currently supported spawning populations of bull trout, such as the Samish River and Duwamish River. Bull trout are believed to be foraging on juvenile salmonid downstream migrants or other fish species while occupying these areas.

6.2.1.2 Distribution and Ecology of Juveniles

Current information suggests that bull trout first enter tidally influenced waters in Puget Sound as age-2 fish. The size of juvenile fish at marine entry may range 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. The Skagit River provides the only long-term monitoring point for juvenile bull trout downstream migration timing. The WDFW operates a scoop trap and screw trap near Mt. Vernon, which lies within the range of tidal influence. Since 1990 they have captured over 2000 juvenile bull trout at the trap. A cumulative frequency analysis of their catch data 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 into nearshore marine areas. Larger juveniles may elect to migrate substantial distances through the nearshore marine environment from the 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.

6.2.1.3 Habitat Use

Migratory (fluvial, adfluvial, and anadromous) bull trout habitat use of off-channel areas in floodplain areas (freshwater and tidally influenced) has been little studied 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 there is increasing information available showing that sub-adult and adult bull trout use lower elevation floodplains in freshwater and tidally influenced areas.

In the Puget Sound basin, other observations of bull trout use of freshwater floodplain areas have been recorded in: 1) the lower end of South Fork of the Nooksack River, in Black Slough in a beaver dam complex (N. Currence, Nooksack Tribe, pers. comm.); 2) the North Fork Stillaguamish River, in a slough at the mouth of McGovern Creek (C. Kraemer, WDFW, pers. comm.); 3) the Skagit River, in Manser Slough near Parker Creek at RM 40 (E. Conner, Seattle Public Utilities, pers. comm.); 4) the Upper Skagit, at Park and Nehalem Sloughs near Nehalem, caught by smolt trapping (C. Kraemer, WDFW, pers. comm.).

In Puget Sound tidally influenced floodplain areas, subadult bull trout have been observed or captured in restored (three locations) and natural tidal channels (two locations) and larger distributary channels in: 1) 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.); 2) the Snohomish River, in two small tidal channels off Ebey Slough, a large distributary channel (M. Rowse, NMFS, unpublished data); 3) the Snohomish in Union Slough, in the spring of the first year after dike removal and restoration of a previously isolated floodplain area on Spencer Island (Tanner et al. 2002); 4) 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); 5) 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).

Subadult and adult bull trout that enter marine areas pass through or use a wide range of habitats for short or longer-term habitation. The Seattle District Corps has been conducting a multi-year acoustic telemetry study of sub-adult and adult bull trout use of nearshore marine waters from the Snohomish River to Padilla Bay. Recent data from the Seattle District study has shown that fish tracked in nearshore and lower river areas were not found at temperatures exceeding 60° F except for one observation at 64° F.

Prior to this study no information was available on the range of salinities bull trout may elect to use. To date, during the documented marine residence phase, March to July, fish have been found in salinities from 1 to 28 parts per trillion (ppt) – during this time period salinity does not appear to be limit the habitats bull trout may elect to use. Substrate class does not appear to be important to selection of feeding areas or home territories (see below), as fish were found using substrates from mud, to sand, to large gravels. Turbidity levels also do not appear to influence the habitats selected by sub-adult and adult fish, as the highest density of tagged fish during the study was found in a high turbidity area of Snohomish River delta.

Depth range may change by time of day and may vary by age class. During one nearshore marine tracking survey, the largest tagged fish was found to occupy depths of 30 to 60 feet, a moderate sized was found at 10 to 20 fish and a subadult was found at 5 to 10 feet. The largest tagged fish was found to vary depth by time of day, with the greatest depths occurring during daylight hours and the shallowest depths at night.

6.2.1.5 Prey

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 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 chinook salmon migration (F. Goetz, USACE, pers. comm.). Only one published report has examined bull trout stomach contents and published the results (Footen 2000, 2003) -these fish ate 40 percent salmon, 60 percent forage fish – 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.).

6.2.1.6 Migratory Behavior

Data from the Seattle District study has shown that sub-adult and adult fish show a variety of migratory behaviors in estuary and marine waters including 1) inter-basin migrations of sub-adult and adult bull trout through marine waters whereby fish using any one estuary may come from multiple nearby basins; 2) fish 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; 4) searching behavior where they occupy a feeding area for short periods (days to weeks) before moving to another area; 5) periodic movement back and forth between fresh and saltwater during the typical marine residency period; and 6) change in depth by time of day and by individual fish (discussed above).

In the first year (2002) 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 estuary study area (during late spring and early summer) have occurred in the Skagit River basin. These fish (sub-adult and adult) have been reported or detected throughout the Skagit River basin, from the Whitechuck River, Upper Sauk, mainstem Skagit below Baker River, down to the estuary. These fish were originally tagged at various places within the study area, including the upper Snohomish River, lower Snohomish, and the nearshore marine shoreline north of the Snohomish (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. This same type of interbasin transfer is being documented by radio telemetry in rivers of the West Olympic Peninsula (S. Brenkman, NPS, pers. comm.). Migration by individual bull trout between river basins is a frequent occurrence in fresh water and is well documented. Prior to recent study, migration by bull trout between basins through estuarine and marine waters has little documentation. The occurrence of marine interbasin migration has been previously reported only for a very few selected individuals based on tag returns to the Washington Department of Fish and Wildlife.

Bull trout may reenter marine waters for a limited period during fall to return to the previous spring/summer feeding area. Fall rains or freshets may trigger this movement. As part of the Seattle District study, during mid-November 2002, approximately 10 of the tagged fish reentered marine waters briefly, immediately after the first rain and increase in river flow after four months of drought. Several of these fish returned to areas they were tagged at in spring 2002. All of these fish returned to freshwater areas by early December. Tagged fish did not reenter marine areas again until early March 2003.

Bull trout may home to a feeding territory that they may occupy for up to four months (winter, spring, and early summer). In the first year of study, 98 percent of all tagged fish (49 of 50) left the tidally influenced areas by July 31, with one fish in freshwater tidal areas remaining until August 12. 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. 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. These territories may range in size from 1 to 2 kilometers in size and from 100 to 500 meters in shoreline length. In contrast to the feeding territory pattern, other individual fish display searching behavior, where they may be tagged at one location but are tracked at multiple locations in marine, estuarine, and freshwater.

6.2.2 Occurrence in the Project Area

In recent years, bull trout have been documented in Shilshole Bay at the outlet of the Lake Washington system between May and July. Anadromous bull trout were caught below the Locks in May to July 2000, during a Muckleshoot predator monitoring study. Of the seven bull trout caught below the Locks in 2000; one was caught two times. These fish averaged 360 mm in size, corresponding to lengths of mostly sub-adult fish The diet of these fish include approximately 40 percent juvenile chinook sand chum salmon and 60 percent forage fish including sand lance and surf smelt (Footen 2000, 2003). In 2001, an adult bull trout was captured migrating through the fish ladder in May, three adult bull trout were captured immediately below the spillway tailrace in mid-June, and an adult was captured in the large locks in late June (F. Goetz, USACE, pers. comm.). The three adult bull trout caught below the tailrace (in one seine set) were caught at the peak of juvenile chinook migration. A large juvenile bull trout (approximately 225 mm) was caught in the lower Cedar River in July 1998 during Crops monitoring after dredging (Martz pers. comm.).

The origin of the fish mentioned above is unknown. No anadromous stocks of bull trout are known to occur in the Lake Washington Basin. The Lake Chester Morse population is found above an anadromous barrier. Possibly, small numbers of bull trout may be entrained in the hydropower project and passed downstream (D. Paige, SPU, pers. comm.). Anadromous bull trout found below the Locks are suspected to originate either from the Skagit or Snohomish River basins based on results of the Seattle District multi-year telemetry study.

Bull trout have been documented in the Green River, although they are rarely observed and the USFWS considers the Green River subpopulation as “depressed” (USFWS 1999). Recent discussion by the Puget Sound Technical Recovery Team has concluded that it is unlikely that there is a spawning population of bull trout in the Green River basin. The Green River was described as possessing a “few” Dolly Varden during the 1930s (Pautzke and Meigs 1940). A single native char was reported in Soos Creek in 1956. In April 1978, four adult char were caught by fisherman near the upper range of saltwater intrusion near a site called North Wind weir (D. Moore, MIT, pers. comm.), and a single native char was also observed at the mouth of the Duwamish River in the spring of 1994 (E. Warner, MIT, pers. comm.). In the past three years nine sub-adult and one adult bull trout (total of ten fish) have been captured in the Duwamish River, all by consultants working for the Port of Seattle. The most recent capture occurred at Kellogg Island in May 2003. This fish was a large adult, 585 mm, apparently with a full stomach. This fish was recaptured several hours later near where it was released downstream at the Herring House restoration site (J. Shannon, Taylor and Associates; E. Jeanes, R2 Resource Consultants, pers. comm.).

Taylor and Associates has captured nine subadult char within the lower Duwamish River at the Turning Basin – six in August, and two in September 2000 and one fish in September 2002. The size of these fish ranged from 223 to 370 mm with a mean size of about 290 mm, corresponding to mostly sub-adult sized fish. Environmental conditions were not measured at the time of capture in 2000; the single fish captured in 2002 was caught at a water temperature of 64° F. The average size of these fish is smaller than fish sampled out of any other estuary in western Washington – Snohomish, Skagit, Grays Harbor, Shilshole Bay, and Commencement Bay. The timing of capture of these fish is largely outside the range of fish capture for all other estuaries.

6.2.3 Analysis of Effects

As previously described in the FY 2001-2005 Maintenance Dredging BA (USACE 2000a), the effects of dredging and disposal operations would have a negligible effect on juvenile salmonids and their habitat (see Section 5.3.1.1). Bull trout prey populations are thus unlikely to be affected by the proposed dredging and disposal operations. The sensitivity of bull trout to cold waters limits their potential presence within the lower Duwamish River in the summer months. Bull trout may migrate through the action area from spawning areas and may forage within the action area during periods of juvenile salmonid out-migration. Their occurrence in the action area during the winter dredging period (October 16 to February 14) is unlikely based on the lack of out-migrating juvenile salmonids to prey upon, observed migratory behavior of bull trout from other areas, and the expected low numbers of fish over-wintering in the upstream, freshwater areas of the Green/Duwamish River basin.

This information, in combination with the conservation measures described below (Section 6.2.5), 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.

6.2.4 Take Analysis

If the proposed dredging operations were to be conducted during migration periods, bull trout could be susceptible to short-term harassment during their migration periods. Maintenance dredging could create the likelihood of injury to such an extent as to significantly disrupt normal behavior patterns during peak migration periods. However, adoption of the conservation measures (Section 5.2.5), particularly avoidance of the juvenile salmon migration period, reduces the potential for incidental take in the form of harm or harassment of bull trout to a negligible level.

6.2.5 Conservation Measures

The conservation measures previously described in the FY 2001-2005 Maintenance Dredging BA (USACE 2000a) to minimize effects on chinook salmon would also minimize effects on bull trout. These conservation measures are summarized below.

Avoiding dredging during peak salmonid outmigration periods would minimize the short-term effects of the proposed action on bull trout. Measures incorporated into the proposed action, including the dredging scheduling and permit conditions, would reduce the incremental effects such that there would be minimal effects on bull trout. The proposed dredging would be conducted between October 16 and February 14. Dredging during peak juvenile salmon migration months between February 15 and July 15 (or as designated by NOAA Fisheries, USFWS, or WDFW) would thus be avoided. This timing would also avoid noise impacts to juvenile salmonids.

The principal water quality impact of dredging is increased suspended solids concentrations in waters near the dredging site. The effects of dredging on water quality can occur at the site of dredging and transfer to the barge and barge overflow or decant water discharge. The dredging for this project would be accomplished with a clamshell dredge where 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. These effects are all temporary and localized. They are limited in time to periods outside the fish window and are limited in space to the immediate vicinity of dredging activities. Temporary effects on water quality and salmonids would also be minimized by adherence to permit conditions and by additional measures, which are detailed below:

(1) Dredging would be done with a clamshell dredge, and would be carried out in a manner that minimizes spillage of excess sediments from the bucket and minimizes entrainment of fish.

(2) Barges used to transport the dredged material to the disposal or transfer sites would not be filled beyond their capacity to completely contain the dredged material.

(3) Disposal operations and material effects would be in conformance with PSDDA management standards.

(4) Other conditions as may be included in the Section 401 Certification issued by the Washington State Department of Ecology (WDOE) for this project (see description in Section 4.1.1).

(5) Dredging would be carried out in compliance with permits issued by the responsible regulatory agencies. These permits may include additional conditions to protect water quality.

6.2.6 Effect Determination

Sub-adult bull trout have been documented in the Duwamish Waterway. Therefore, the project may affect the threatened Coastal/Puget Sound bull trout. However, any bull trout present would experience negligible effects from the proposed dredging operations, as described in Section 6.2.3. Conservation measures (as described in Section 6.2.5), including avoiding dredging during the juvenile migration period, would prevent adverse short-term effects to bull trout during dredging operations. Dredging would result in temporary degradation of the water quality; these effects would be limited to the immediate dredging site. The temporary loss of the benthic and forage fish communities in the dredge area would have only a negligible effect on bull trout habitat, especially since juvenile bull trout forage mainly outside of the navigation channel. In the unlikely event that bull trout would be present during dredging, they would be expected to readily avoid the project area during dredging operations. 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.

6.3 Bald Eagle

The bald eagle was initially listed as endangered under the Endangered Species Act in 1978 throughout the lower 48 states, except in Minnesota, Michigan, Wisconsin, Washington, and Oregon, where it was listed as threatened. In 1995, the U.S. Fish and Wildlife Service reclassified the bald eagle from endangered to threatened throughout the lower 48 states due to the steady increase in their populations. On July 6, 1999, the U.S. Fish and Wildlife Service announced a proposal to delist the bald eagle under the Endangered Species Act in 1978. However, formal delisting of the species has not yet occurred.

6.3.1 Description of Species

The bald eagle is found along the shores of saltwater and freshwater lakes and rivers. In Washington, breeding territories are located in predominantly coniferous, uneven-aged stands with old-growth components. Territory size and configuration are influenced by a variety of habitat characteristics, including availability and location of perch trees for foraging, quality of foraging habitat and distance of nests from waters supporting adequate food supplies. Habitat models for nesting bald eagles in Maine show that the eagles select areas with (1) suitable forest structure, (2) low human disturbance, and (3) highly diverse or accessible prey (Steenof 1978).

Although bald eagles may range over great distances, they usually return to nest within 100 miles of where they were raised. They typically mate for life. Their nest tree is usually the dominant tree in the canopy and they are often built within a mile of the water body used for foraging. Bald eagles typically build nests in mature old-growth trees, which are generally used in successive years. In Washington, courtship and nest-building activities generally begin in January and February. Egg laying begins in March or early April, with eaglets hatching in mid-April or early May. Eaglets usually fledge in mid-July and often remain in the vicinity of the nest for another month (Steenof 1978).

Bald eagles are adaptable, feeding on whatever is most expedient. Eagles often depend on dead or weakened prey, and their diet may vary locally and seasonally. Various carrion, including spawned salmon taken from gravel bars along wide, braided river stretches, serve as important food items during fall and winter. Waterfowl often are taken as well. Anadromous and warm-water fishes, small mammals, carrion, and seabirds are consumed during the breeding season (Steenof 1978). In winter, northern birds migrate south and gather in large numbers near open water areas where fish or other prey are plentiful.

6.3.2 Occurrence in Project Area

Nesting and wintering populations in almost all recovery areas in Washington, including the West Cascade Mountains recovery zone, have reached levels that may allow de-listing. In the state of Washington just over 100 nesting pairs of eagles were documented in 1978. Since that time, the nesting population has increased to approximately 600 pairs (WDFW 1999). Several hundred additional bald eagles occupy rivers and streams associated with the Skagit River system each winter between approximately October 31 and March 31 to feed on carcasses of salmon that have returned to spawn. Wintering populations in Washington are thought to be stable or increasing. However, habitat loss, degradation, and major disturbance factors continue to be serious problems that must be guarded against to assure population gains are not diminished.

Adult, sub-adult, and juvenile bald eagles are commonly sighted flying over or perched along the lower Duwamish River and are known to forage within and around Elliott Bay and the Duwamish Waterway where they are year-round residents. Due to the industrialized nature of the lower Waterway and the lack of significant trees for nesting, there are no documented nests within the vicinity of the proposed dredging. Similarly, wintering bald eagles do not generally concentrate along the lower Duwamish River or Elliott Bay.

The nearest bald eagle nest to the dredging operation is located north of the north end of Kellogg Island, on the western bluff, overlooking the waterway, west of West Marginal Way. This nest is approximately five miles downstream of the proposed dredging operation. This nest was active in 2002, but nesting has not been confirmed in 2003 (J. Stofel, WDFW, personal communication, June 18, 2003). The nearest bald eagle nest to the disposal operations is located at Duwamish Head, approximately six miles downstream of the proposed dredging and approximately one mile southwest of the Marine Sediment Unit and 1.5 miles southwest of the PSSDA open water disposal site (WDFW PHS database search June 5, 2003). This nest is frequently referred to as the "Salty's" nest due to its proximity to the Salty's at Alkai Restaurant and is a well-established territory with yearly nesting activity.

Three bald eagle nests have been documented in Seward Park, approximately four miles northeast of the Turning Basin, and one nest is located on the southern end of Mercer Island, approximately 3.7 miles east of the Turning Basin. One bald eagle nest has also been documented in Seahurst Park, approximately 4.25 miles southwest of the Turning Basin (WDFW PHS database search June 5, 2003).

6.3.3 Analysis of Effects

Potential effects of the proposed maintenance dredging on bald eagles include disturbance from the dredging and disposal activities and increased turbidity around the Turning Basin during dredging that may inhibit foraging or result in temporarily reduced food availability. Noise (running heavy equipment) and temporary increases in turbidity during dredging and disposal will likely cause prey fish and waterfowl to avoid the immediate area of the dredging and disposal operations. Consequently, resident or wintering bald eagles are expected to temporarily avoid the immediate area and forage elsewhere until dredging operations are completed.

Because the action area represents a small portion of the foraging habitat locally available for bald eagles along the shoreline of central Puget Sound, any such interference with bald eagle foraging activity is expected to be insignificant and discountable, ending when the dredging and disposal activities are completed. Similarly, because resident and wintering bald eagle populations in this area are likely acclimated to frequent boat and barge traffic on both the lower Duwamish River and Elliott Bay, no long-term effects on habitat suitability or bald eagle foraging behavior are expected. 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.

Although dredging and disposal activities could take place during early portion of the nesting season (January through February 14), survival and reproductive success of bald eagles at the Duwamish Head and the West Marginal Way nests will be unaffected. Nesting bald eagles in these areas have repeatedly nested and fledged young in highly industrialized and frequently disturbed areas. Thus, these birds are likely fairly acclimated to the passage of dredges and barges, and to frequent, temporary increases in noise levels along Elliott Bay and the lower Duwamish River. The West Marginal Way nest is elevated well above and away from the Duwamish River channel; nesting bald eagles in this nest are unlikely to be disturbed by the slow passage of the dredge and its barges through the waterway. Similarly, bald eagles on the Duwamish Head nest are also unlikely to be disturbed by the slow transit of the bottom-dump barge to the disposal site and the release of sediment into the water column during dumping.

Long-term degradation of bald eagle habitat is also not expected. Bald eagle prey availability should also not be substantially affected while the benthic community reestablishes along the dredge channel and within the disposal areas. Use of the dredged material to contain the contaminated sediments at within the Marine Sediment Unit may ultimately limit the possible exposure of foraging bald eagles to bioaccumulated toxins in their food web.

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

6.3.4 Take Analysis

Although foraging activities of bald eagles may be temporarily disturbed during dredging and disposal operations, this disturbance is not expected to significantly disrupt normal behavior patterns sufficiently to create the likelihood of injury or 'take' of any bald eagles. Therefore, the potential for incidental take in any form (including harassment) is considered negligible.

6.3.5 Conservation Measures

No specific conservation measures are warranted, because the potential for adverse effects on the bald eagle from short-term dredging and disposal operations is negligible. Conservation measures described in Section 5.2.5 for bull trout are expected to also benefit bald eagles by limiting effects on their salmonid prey.

6.3.6 Effect Determination

Proposed maintenance dredging and disposal activities will not result in any long-term degradation of habitat or other significant adverse effects on bald eagles. 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 bald eagles in the project vicinity would not be affected. Therefore, the proposed maintenance dredging activities **may affect, but are not likely to adversely affect** the bald eagle.

6.4 Marbled Murrelet

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.

6.4.1 Description of Species

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 nest in low-elevation, mature forests with multi-layered canopies; they select large trees with horizontal branches of at least seven inches in diameter and heavy moss growth and lay a single egg in the nest. April 1 through September 15 is considered nesting season; however in Washington, marbled murrelets generally nest between May 26 and August 27 (USFWS 1999b). Nesting trees in Washington State have been found as far as 30 miles from the ocean. Adults feeding young fly between terrestrial nest sites and ocean feeding areas primarily during the dawn and dusk hours.

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, seaperch, sardines, rockfish, capelin, smelt, as well as euphasiids, 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, and natural and anthropogenic (human-induced) variability in prey availability are concerns for this species.

6.4.2 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 within the vicinity of Elliott Bay or the Duwamish River. Similarly, no designated critical habitat (i.e. terrestrial nesting habitat) is located in or along the shores of Puget Sound, Elliott Bay, or the Duwamish River. Designated critical habitat does not include marine foraging habitat.

The closest nesting areas to the lower Duwamish River and Elliott Bay are located approximately 35 to 40 miles to the east in the Cascade Mountains of King County (approximately eight nesting areas) and approximately 30 to 50 miles to the west in the Olympic Mountains of eastern Jefferson and Mason Counties (approximately 20-30 nesting areas) (Priority Habitats and Species database search June 5, 2003).

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 and Voice of America on the Olympic Peninsula, 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 and Elliott Bay, marbled murrelets are not commonly seen in Elliott Bay, but could occur in the vicinity of either potential disposal site. The industrialized nature and shallow depths of the lower Duwamish River make the occurrence of marbled murrelet in the vicinity of the proposed dredging extremely unlikely.

6.4.3 Analysis of Effects

Potential effects of the proposed maintenance dredging on marbled murrelets primarily include disturbance and increased turbidity during disposal of dredged sediments that may inhibit foraging or result in temporarily reduced food availability. Noise (running heavy equipment) and temporary increases in turbidity during dredging and disposal will likely cause prey fish to avoid the immediate area of the dredging and disposal operations. Consequently, in the unlikely event that a marbled murrelet was present within the immediate vicinity of the disposal areas, they would be expected to temporarily avoid the immediate area and forage elsewhere until disposal operations are completed.

Because the action area represents a small portion of the foraging habitat locally available for marbled murrelets within Puget Sound, any such interference with murrelet 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.

Any interference with murrelet activity will end when construction 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. Use of the dredged material to contain the contaminated sediments at within the Marine Sediment Unit may ultimately limit the possible exposure of foraging marbled murrelets to bioaccumulated toxins in their food web.

For the reasons described in Section 5.4, 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.

6.4.4 Take Analysis

If marbled murrelets are present in Elliott Bay during disposal operations, foraging activities may be temporarily disturbed. However, this disturbance would not be expected to significantly disrupt normal behavior patterns sufficiently to create the likelihood of injury or ‘take’ of any marbled murrelets. Therefore, the potential for incidental take in any form (including harassment) is considered negligible.

6.4.5 Conservation Measures

No specific conservation measures are warranted, because the potential for adverse effects on the marbled murrelet from short-term dredging and disposal operations is negligible. Conservation measures described in Section 6.2.5 for bull trout are expected to also benefit marbled murrelets by limiting effects on their fish prey.

6.4.6 Effect Determination

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 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. Similarly, the proposed maintenance dredging and disposal activities are **not likely to adversely modify** marbled murrelet critical habitat as those activities would not occur within designated critical nesting habitat or surrounding forest areas.

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