Appendix P

Preliminary Draft Biological Assessment

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APPENDIX P

Preliminary Draft Biological Assessment

This preliminary draft BA has been prepared as part of the Port of Portland Engineering Evaluation/Cost Analysis to define the structure and general content for a formal draft BA for the purposes of analyzing compliance with ARARs. Species selected for assessment have not been formally verified with the appropriate agencies.

ENGINEERING EVALUATION/COST ANALYSIS APPENDIX P

PRELIMINARY DRAFT BIOLOGICAL ASSESSMENT FOR FEDERALLY LISTED SPECIES

TERMINAL 4 REMOVAL ACTION
PORT OF PORTLAND
PORTLAND, OREGON

DRAFT DOCUMENT: Do Not Quote or Cite.
This document is currently under review by US EPA and
its federal, state and tribal partners, and is subject to change in whole or in part.

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P-1. *Introduction and Background*

In 2000, the U.S. Environmental Protection Agency (USEPA) added the Portland Harbor Superfund Site (Superfund Site or Site) to the National Priorities List (NPL) pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. § 9601, *et seq*. (CERCLA or Superfund) (USEPA, 2001). The Superfund Site Initial Study Area encompasses about six miles of the Willamette River in Portland, Oregon and includes the Terminal 4 facility. The Port of Portland (Port) owns Terminal 4 and leases land there to several marine tenants.

In fall 2001, the USEPA and ten of the Superfund Site's potentially responsible parties entered into an Administrative Order on Consent for a Remedial Investigation/Feasibility Study (RI/FS), CERCLA-10-2001-0240 (USEPA, 2001). The RI/FS will characterize the nature and extent of contamination and assess the biological and human health risks at the Superfund Site. The Administrative Order on Consent allows Early Actions to be conducted to address known contamination at specific locations within the Superfund Site. Contaminants found in Terminal 4 sediment samples during a RI led by the Oregon Department of Environmental Quality (DEQ) led to a determination that a Removal Action at Terminal 4 is warranted. Accordingly, the Port is conducting a Non-Time-Critical Removal Action under an Administrative Order on Consent for Removal Action (here after the AOC), CERCLA 10-2004-0009, executed by the Port and USEPA in October 2003.

The AOC requires the Port to conduct an engineering evaluation and cost analysis (EE/CA) for the Terminal 4 Removal Action in which various Removal Action alternatives are described, compared and ranked for their relative performance at meeting CERCLA criteria for non-time-critical removal actions (NTCRA). The EE/CA then presents the Preferred Alternative based on the outcome of the comparative analysis and ranking. Based on the evaluation presented in the EE/CA, the USEPA will select the Removal Action and document its decision in an Action Memorandum. The objective of the Removal Action is to reduce ecological and human health risks associated with sediment contamination within the Removal Action Area to acceptable levels.

The Removal Action described in the AOC is considered an agency action under the Endangered Species Act (ESA) and is therefore required to substantively comply with the ESA. The ESA of 1973 (as amended) requires protection of threatened and endangered species and their habitats. Section 7(a)(2) of the ESA requires that each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. Section 7 of the ESA further requires, that for a major construction activity, the action agency submit a biological assessment (BA) if listed species or designated critical habitat may be present in the action area.

This document presents the preliminary draft BA, required under the AOC, and is Appendix P to the EE/CA report. It evaluates potential effects of the Preferred Alternative on federally listed and proposed threatened and endangered species for the purpose of evaluating compliance with the substantive requirements of the ESA in the context of the EE/CA applicable or relevant and appropriate requirements (ARARs) analysis. A formal draft

BA will be prepared after the USEPA issues the Action Memorandum and selects the Preferred Alternative to be conducted at Terminal 4. Because the Preferred Alternative is at the conceptual phase of design, this preliminary draft BA is conceptual and will likely be refined after design is completed.

P-1.1 Action Area and Project Setting

The Removal Action Area is within the Port's Terminal 4 Facility located at 11040 North Lombard Street in Portland, Oregon. Terminal 4 is within or adjacent to the Superfund Site on the eastern shore of the Willamette River just downstream of the St. Johns Bridge and between River Miles 4 and 5 (see Figures P-1 and P-2 for a vicinity map and aerial photograph of the Port's Terminal 4 property). The Terminal 4 Removal Action Area is shown on Figure P-3. The Removal Action Area is defined in the AOC as follows:

- Removal Action Area or "Terminal 4 Removal Action Area"...shall mean that portion of the Site adjacent to and within the Port of Portland's Terminal 4 at 11040 North Lombard, Portland, Multnomah County, Oregon: extending west from the ordinary high water line on the northeast bank of the lower Willamette River to the edge of the navigation channel, and extending south from the downstream end of Berth 414 to the downstream end of Berth 401, including Slip 1, Slip 3, and Wheeler Bay.

The AOC requires the Port to conduct an EE/CA of various alternatives for the Terminal 4 Removal Action. For the purposes of site characterization under the EE/CA, the site characterization study (BBL, 2004b) sub-divided the Terminal 4 Removal Action Area into five subareas based on an initial evaluation of sediment chemistry, operational and engineering considerations (Figure P-3):

- Berth 401;
- Slip 1;
- Wheeler Bay;
- Slip 3; and
- North of Berth 414.

The BA also uses these subareas for the analysis of baseline conditions and effects. The Removal Action Area (also referred to herein as the project site) encompasses roughly 38 acres, of which Slip 1, Slip 3, and Wheeler Bay make up about 28 acres, while the area from the mouths of the slips to the Harbor Line encompasses approximately 10 acres.

The Removal Action will occur in an aquatic environment and may increase turbidity in work areas. Turbid waters could be transported to areas outside of the Removal Action Area. Thus, the action area for aquatic species and habitat not only includes the immediate Terminal 4 Removal Action Area, but also those areas that could be directly or indirectly affected by the proposed action. For purposes of this BA, the action area for aquatic species and habitat is defined herein as the mainstem Willamette River in the vicinity of the Terminal 4 Removal Action Area, including 0.3 miles (River Mile 5.0) upstream of Terminal 4 and downstream to the Multnomah Channel (River Mile 3.5). For terrestrial wildlife species, the action area is within a 0.5 mile radius from the project site, which is consistent with recent biological assessments for activities in the Terminal 4 facility (Port of Portland and Ellis Ecological Services, 2004a).

Terminal 4 is an active marine terminal and as such has periodic maintenance dredging. Dredging activity at Terminal 4 began with the work that provided fill for the general terminal space and created Slips 1 and 3 between 1917 and 1921. In the process, the former Gatton's Slough and adjacent Willamette River shoreline were reconfigured. The Port's dredging activities provided dredged material for the City of Portland's Commission of Public Docks facility. Maintenance dredging of the slips and improvements to the terminal's harbor face occurred periodically in ensuing years. Slip 1 was last dredged in 1988 and Slip 3 was last dredged in 2003.

Landuse surrounding Terminal 4 is industrial. The upland area comprises about 283 acres (Parsons Brinkerhoff, 2002) including the Toyota lease areas, and is generally flat in grade in proximity to the slips. The surface covering is primarily asphalt, with minor areas of gravel and/or ballast associated with the rail lines. At present, a relatively large volume of sand is stockpiled within the Slip 1 uplands because of recent grading of the adjacent Toyota facility. The EE/CA work plan (BBL, 2004a) summarized local conditions and information is included in the Environmental Baseline section of this BA.

The City of Portland's Public *Review Draft of the Framework for Integrated Management of Watershed Health* (2004) provides a description of the local setting of the Portland area and the Lower Willamette River, and excerpts are included below:

> Portland is situated at 20 feet above sea level, near the confluence of the Columbia and Willamette rivers, about 65 miles inland from the Pacific Ocean. It lies midway between the lower Coast Range to the west and the high Cascades Range to the east, each about 30 miles distant. Portland's varied topography includes steep hills, isolated volcanic cones, low rolling hills and extensive flat areas. The area is composed primarily of alluvial deposits and Columbia River basalts. Much of the city is located in the Willamette Valley Plains ecoregion, although steeper portions of the Tualatin Hills on the west side are characteristic of Willamette Valley Hills and Coastal Mountains ecoregions (Clarke et al., 1991).
>
> Portland has a mild marine climate that is heavily influenced by the mountain ranges east and west of the city. The Coast Range protects the Portland area from Pacific storms, while the Cascades prevent colder continental air masses from invading western Oregon. In winter, the average temperature is 40°F and the average minimum temperature is 34°F. In summer the average temperature is 65°F with an average daily maximum of 74 to 78°F (Rockey, 2002).
>
> The Cascades also lift moisture-laden westerly winds from the Pacific, driving local rainfall patterns. Average annual rainfall in the Portland area is approximately 37 inches. Nearly 90 percent of the annual rainfall occurs from October through May. Only 9 percent of the annual rainfall occurs between June and September, with 3 percent in July and August. Precipitation falls predominantly as rain, with an average of only five days per year recording measurable snow.
>
> The City of Portland's estimated 2000 population was nearly 530,000, and the City's population is expected to be approximately 589,000 by 2017. Land uses in the Portland area include industrial, commercial, low- and high-density residential and open space.
>
> The Willamette River is a tributary to the Columbia River at approximately River kilometer (Rkm) 164 (River Mile [RM] 102). It is the 10th largest river in the contiguous United States in terms of

streamflow. The Willamette Basin is 11,460 square miles in size and constitutes 12 percent of the land area of Oregon (Willamette Restoration Initiative, 1999). In 1990, about 70 percent of Oregon's population lived in the Willamette Basin. The Willamette Basin is divided into 12 subbasins. The lower reach of the Willamette—the subbasin which includes the City of Portland—extends from the mouth upstream to the falls at Oregon City (RM 26.5, Rkm 42 of the Willamette River).

Land uses within the lower Willamette River watershed in the vicinity of Portland and its suburbs are urban/industrial, residential and rural/agricultural. Many of the state's heaviest industrial users are present in the Lower Willamette watershed. Land uses in the basin upstream of Portland include timber production, grazing, irrigated and dryland agricultural and urban areas.

Further information on the action area and environmental baseline conditions within the action area are described below in Section 5.0 of the BA.

P-1.2 Listed Species and Evaluation Methods

Table P-1 lists threatened, endangered and candidate terrestrial species that may occur within the action area. Table P-2 lists Pacific salmonid evolutionary significant units (ESUs) that are listed under the ESA, and that may occur within the action area. The species given in Tables P-1 and P-2 were obtained from U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) most current species lists (NOAA Fisheries, 2004b; USFWS, 2004) posted on their respective websites. The BA compiles the best available scientific and commercial data for the action area, and considers the current environmental baseline, species information and key habitat elements in the action area that may be affected by the proposed action. Factors considered include effects to listed and proposed species, the species biological requirements and life history information, habitat components and conditions within the action area, distribution and abundance of listed species, and the potential for impacts to critical habitat and the ability to minimize and mitigate for adverse effects identified. The methods outlined in "*Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale"* (NOAA Fisheries 1996) and the "*Endangered Species Consultation Handbook*" (USFWS and NOAA Fisheries, 1998) were used as guides to analyze potential effects. The BA's effects determination is based on this information and uses this information to determine whether the proposed action is likely to adversely affect listed species or designated critical habitat, and to determine whether formal consultation or conferencing is necessary.

P-1.2.1 Other Species Considered

There were other listed species initially considered during this analysis, but they were determined to not warrant further analysis based on previous, but recent, BA's completed for projects within the vicinity of Terminal 4. The following BAs have recently been prepared for actions in the Lower Willamette River in the vicinity of the action area:

- Biological Assessment – McCormick and Baxter Creosoting Company, Portland, Oregon (Oregon DEQ and USEPA, 2002);
- Biological Assessment – Bank Excavation and Backfill Remedial Action marine Terminal 4, Slip 3 Upland Facility: Addressing Potential Impacts on Federally Listed Wildlife and their Habitats (Port of

Portland and Ellis Ecological Services, 2004a); and

- Biological Assessment – Cantilevered Sheet Pile Wall Installation, Marine Terminal 4, Slip 3: Addressing Potential Impacts on Federally Listed Fish and Wildlife and Their Habitat (Port of Portland and Ellis Ecological Services, 2004b).

The first two BAs were prepared to assess the potential effects of nearshore excavations for the purpose of controlling continued contaminant release to the Willamette River. The third BA was prepared to assess the potential effects of installation of a sheet pile wall to provide structural stability to the pier, the sediments, and the bank under the pier at the project site in Slip 3. The sheet pile wall was also necessary to excavate and cap contaminated sediments in Slip 3 as part of this USEPA Removal Action. The BAs reported that several species listed as threatened or endangered for this area, are not present in the lower Willamette River near the McCormick and Baxter site as well as Terminal 4. The more recent BAs for Slip 3 in Terminal 4 examined Oregon Natural Heritage Information Center records as well as the list of species provided by the USFWS. Species not present in the action area included the following: Golden paintbrush, Willamette River daisy, Howellia, Bradshaw's lomatium, Kincaid's Lupine, and Nelson's checker mallow. Based on these previous determinations of absence in the action area, which overlaps the subject Removal Action Area and action area, no further analysis of these species is included in this BA.

Green sturgeon (*Acipenser medirostris*), Pacific lamprey (*Lampetra tridentata*), river lamprey (*Lampetra ayresi*), and coastal cutthroat trout (*Oncorhynchus clarki clarki*) are categorized as species of concern by the USFWS and may occur in the action area. It is anticipated that measures taken to minimize adverse effects to listed Pacific salmonids would also minimize effects to these species of concern.

P-2. *Proposed Action*

P-2.1 Selection of the Preferred Alternative

In accordance with NTCRA guidance (USEPA, 1993), the EE/CA identifies and assesses a limited number of alternatives based on the nature and extent of contamination and on their ability to address Removal Action Objectives (RAOs). The physical, chemical and operational attributes of the five subareas within the Removal Action Area were considered during the development of the four Removal Action alternatives. The nature and extent of contamination are described in the characterization report (BBL, 2004b) and summarized in the EE/CA. The physical characteristics of each subarea are also described in the characterization report (BBL, 2004b), as well as in the EE/CA, including topography, slopes, surface covering, existing buildings, adjacent structures and other fixtures. In accordance with NTCRA guidance (USEPA, 1993), a limited number of alternatives were identified and assessed based on the nature and extent of contamination and on their ability to address RAOs (see the EE/CA Report for more detailed discussion).

The Preferred Alternative includes a combination of dredging, capping, confined disposal facility (CDF), and monitored natural attenuation (MNR) (Table P-3). Dredging is restricted to the interior of Slip 3. Shoreline areas of Slip 3, including areas beneath the piers at Berth 411 cannot be effectively dredged and will be capped with clean materials. Capping will also be employed along the shoreline of Wheeler Bay, and along the north (downstream) end of the shoreline near Berth 401. A CDF will be installed in Slip 1 and will receive dredged materials from Slip 3. The CDF will be constructed along the entire length of the slip and will be built to grade, eliminating inundated areas in Slip 1 and creating new land surface. The following provides a more detailed description of the preferred alternative.

P-2.2 Removal Technologies

P-2.2.1 Sediment Dredging

Several different dredging and removal technologies (including transport, treatment and disposal technologies) were evaluated. For dredging contaminated materials, the initial design proposes to use either mechanical dredging (clamshell bucket) or hydraulic dredging. If mechanical dredging is used, the material will be placed on a split-hull/bottom-dump barge and then taken to the CDF for disposal. If hydraulic dredging is used, the material will be pumped via pipes directly to the CDF in Slip 1. Advantages and disadvantages of both dredging technologies are being evaluated.

P-2.2.2 Sediment Capping

Capping is a generic term for the in-situ containment of contaminated sediment. Contaminated sediments are covered (capped) by an appropriate material that isolates the contaminants from the water body and from ecological and human receptors. Capping involves the placement of natural material (such as soil or sediment) or a synthetic (man-made) material on top of the contaminated sediment, thereby isolating chemicals from the overlying water. A cap can therefore prevent receptors from having direct contact with chemicals in the sediment as well as prevent or substantially decrease the rate of flux of chemicals from the underlying sediments. A cap will also prevent resuspension and downstream migration of chemicals adsorbed onto suspended sediment. The thickness of the cap is determined using USEPA (1998) criteria (refer to the EE/CA Section 5.2 for criteria). Sediment caps normally require long-term maintenance and a monitoring program, partly to verify that the cap has reduced the mobility of the chemicals and partly to ensure that the cap material is not eroding.

Capping contaminated sediments is a technically feasible technology proposed for both Slips 1 and 3. Capping (or dredging) is also feasible at the north end of Berth 401 where marginal polychlorinated biphenyl (PCB) concentrations were encountered in one sample location (sample location VCO1). Capping was determined to be appropriate in Wheeler Bay in the area along the shoreline where marginally high PAH concentrations and a probable effects concentration (PEC) exceedance for zinc were encountered. Some capping may occur in the North of Berth 414 subarea along with MNR. Capping will require selection of the proper capping material, slope stability analyses, and selection of the proper design and construction procedures. Special consideration during design will be given to protection of the toe of the cap, which may include construction of rock berms, cofferdams or bulkheads that are designed to resist erosion and to provide lateral confinement of contaminated sediments under the cap.

P-2.2.3 Monitored Natural Recovery

MNR is defined by USEPA as a "…sediment cleanup method that uses ongoing, naturally occurring processes to contain, destroy, or otherwise reduce the bioavailability or toxicity of contaminants in sediment" (USEPA, 2002). MNR relies on natural recovery to achieve site-specific remediation objectives within a time frame that is reasonable compared to that offered by more active methods. MNR relies on natural processes that have been defined by the USEPA and include physical, biological or chemical mechanisms that reduce risk associated with chemicals of potential concern (COPCs) in sediment (USEPA, 2002). Based on USEPA (2002) guidance, five components were used to evaluate the feasibility of MNR for contaminated sediments: COPC fate and transport, conceptual and predictive modeling of COPCs, source control, limited COPC exposure during recovery to the extent possible, and an ability to monitor sediment recovery. Detailed analysis of MNR for the site is presented in Appendix H to the EE/CA Report.

MNR is proposed for approximately 26% of the Removal Action Area, restricted to areas outside of Slip 1 and Slip 3, generally in the riverward side of the Removal Action Area adjacent to the federal navigation channel. Sediments in these areas contain the lowest concentrations of COPCs observed in the Removal Action Area. Concentrations are expected to decline in these areas due to the natural processes described above. Sediment will be monitored and, if after 5 years, concentrations are not consistent with RAOs, additional removal or remedial action will be evaluated. Consistency with RAOs will be based on risk criteria and cleanup goals established through the harbor-wide RI/FS process.

P-2.2.4 Confined Disposal Facility

A CDF is an engineered disposal structure for permanently containing dredged material in a nearshore environment. The Preferred Alternative includes construction of a CDF for onsite disposal of dredged sediment. Confinement berms or dikes enclose the disposal area, thereby isolating the dredged sediment from adjacent waters. Confined disposal is a proven technology that isolates contaminants from the aquatic environment and ensures protection of human health and the environment (BBL, 2004a). CDFs are designed to withstand floods and earthquakes. Over the last 20 years, CDFs have been successfully used at other CERCLA sites around the country and within USEPA Region 10 (BBL, 2004a). A CDF is proposed for the Slip 1 subarea.

P-2.3 The Removal Action Preferred Alternative

The Preferred Alternative includes the technologies of removal (dredging), containment (capping), MNR and a CDF. Dredging and disposal in a CDF are the main technologies proposed, addressing 57% of the Removal Action Area. Capping would address about 19% of the Removal Action Area and, with time, MNR would address about 24% of the Removal Action Area. Refer to Figure P-3 for a visual representation of the Removal Action by technology within each subarea. The following subsections describe the Preferred Alternative, specific for each subarea.

P-2.3.1 Berth 401

Berth 401 is approximately 3.5 acres in area with a relatively steep slope. Many areas are covered with riprap and there are remnants of old structures. Berth 401 consists of a T-shaped finger pier that would limit access for dredging and capping equipment, making dredging and capping beneath the pier structure extremely difficult. The maximum depth of detected contaminants encountered was approximately 3 feet. No tenants currently use Berth 401, but grain export has been conducted in the past and the Port is actively marketing the facility to secure a new tenant. Berth 401 is currently used for lay vessel storage.

A relatively small area in the northeast corner of the Berth 401 subarea will be capped because of marginal PCB and phthalate concentrations found at one sampling location. MNR will be conducted in the balance of the area for five years, pending risk criteria developed through the harbor-wide RI/FS cleanup. If after five years concentrations exceed risk-based cleanup criteria, active remediation will be evaluated for the MNR areas.

P-2.3.2 Slip 1-Full At-Grade Confined Disposal Facility (CDF)

The area of Slip 1 to be included in the CDF is 15.3 acres. Approximately half of the Slip 1 area is on relatively steep slopes. The area under existing pier structures at Berths 405 and 408 is about 1.9 acres. The under-pier areas are generally covered with riprap. Several existing pier structures are located in this subarea. Contamination at Slip 1 was characterized (BBL, 2004b) as somewhat spotty and shallow. The depth of detected contaminants in most other areas is between 0 and 3 feet, except an area toward the southwest end of the slip, where the depth of detected contaminants is about 5 feet. MNR is not considered suitable for these areas. The Removal Action consists of construction of an at-grade CDF that will occupy the entire Slip 1. Sediment dredged from Slip 3 will be disposed of in the Slip 1 CDF. The at-grade CDF at Slip 1 would have excess capacity available for other dredged sediments as well.

An earthen containment berm will be constructed at the mouth of Slip 1 to isolate and retain the dredged sediment. Materials used for the berm will be inert and of appropriate dimension to meet engineering requirements. The area under the containment berm will be dredged prior to establishment of the berm. The containment berm will be comprised of 138,500 cy of material with a CDF cap placement of about 255,000 cy of material (upon completion of the filling of the excess capacity in the CDF, the final cap would be placed). About 115,000 cy of sediments from dredging in the Removal Action Area, mainly from Slip 3, would be placed into the CDF as part of the Preferred Alternative. About 20,000 cy of interim capping material may be placed inside the CDF.

There will be approximately 560,000 cy of excess capacity remaining in the CDF for sediments from other cleanup sites in the Portland Harbor Superfund Site. The potential sediment sources are not known, but would be subject to appropriate environmental review. Once the CDF is at-grade, the newly created land may be used for a purpose similar to uses in the surrounding area. Potential future uses are not known, however, any future use would be subject to the Port's storm water management program and other requirements consistent with the Port's and agency requirements.

P-2.3.3 Wheeler Bay-Monitored Natural Recovery and Capping

Wheeler Bay is approximately 7 acres in area, with steeper zones along the shoreline and a beach area. The Berth 410 finger pier separates Wheeler Bay from Slip 3 along the south side of the bay. Contaminants were detected in sediments at variable depths, extending from the surface to beyond 22 feet below the mudline. The EE/CA screening and evaluation determined that dredging would not be feasible. Most sediments within Wheeler Bay are not an immediate concern because of relatively low contaminant concentrations. Therefore, MNR was determined to be the most feasible technology for outer (riverward) portions. Capping will be used along a portion of the steeper slopes and scour protection for the cap will be placed in areas with frequent vessel traffic. Capping is proposed for the area along the shoreline, because of PAH and zinc concentrations.

P-2.3.4 Slip 3-Combination of Dredging, Capping and Monitored Natural Recovery

Slip 3 is approximately 14.4 acres, including slope areas up to the ordinary high water (OHW) level. The bottom of the slip is 9.1 acres and the adjacent slopes are approximately 5.3 acres, including 0.7 acres under the Berth 410 finger pier and 1.7 acres under the Berth 411 pier structure. Slip 3 is an active slip. The Removal Action in Slip 3 will consist of a combination of dredging, capping and a relatively small area of MNR. The evaluation conducted for this area identified MNR as the most appropriate technology under the pier at Berth 410 below the finger pier portion. Data on sediments from MNR will be monitored and concentrations to be compared to Portland Harbor Superfund Site cleanup criteria to determine the need for further action, if any. Elevated risk to the benthic community exists in the eastern portion of Slip 3, toward the head of the slip. The area at Pier 5 will be capped, while the area between Pier 4 and 5 will be dredged. Dredging will be performed in front of Pier 4 to remove contamination. Capping is impractical due to the presence of riprap. Some dredging, but primarily capping, will be used at a relatively small slope area at the head of Slip 3 below the existing pinch pile bulkhead.

P-2.3.5 North of Berth 414-Monitored Natural Recovery

The North of Berth 414 subarea is approximately 3 acres and the entire area is sloped and exposed to the river. The slopes are relatively steep and dredging was considered not feasible. Similar to Wheeler Bay, low contaminant concentrations were found in the North of Berth 414 subarea up to 22 feet below the sediment surface, which also made dredging impractical. Contaminant concentrations are relatively low in this area and no active removal is planned. Monitoring will be conducted for five years. If sediment conditions do not satisfy RAOs after five years, active removal actions will be evaluated. Consistency with RAOs will be based on risk criteria and cleanup goals established through the harbor-wide RI/FS process.

P-3. *Species Accounts*

The following sections describe species life history information and biological requirements, factors limiting the species, and information about the presence of each species within the action area.

P-3.1 Pacific Salmonids

This section defines range-wide biological requirements of Chinook salmon, steelhead, coho salmon and cutthroat trout, as well as ESU-specific information for species that may occur within the action area. Available historical and relatively recent species information is summarized from NOAA Fisheries' coast-wide status reviews (Busby et al., 1996; Johnson et al., 1997; Weitkamp et al., 1995).

The following ESUs of Pacific salmonids are listed as threatened and may use habitat within the action area:

- Lower Columbia River Chinook Salmon (*Oncorhynchus tsshawytscha*);
- Upper Willamette River Chinook Salmon (*Oncorhynchus tsshawytscha*);
- Columbia River Chum Salmon (*Oncorhynchus keta*);
- Lower Columbia River Steelhead (*Oncorhynchus mykiss*); and
- Upper Willamette River Steelhead (*Oncorhynchus mykiss*).

In addition, to the ESUs listed above, the following ESU is a candidate species:

- Lower Columbia River/Southwest Washington Coastal Coho Salmon (*Oncorhynchus kisutch*).

P-3.1.1 Chinook Salmon (Oncorhynchus tshawytscha)

Information on life history and biological requirements can be found in Myers *et al.* (1998) and was used in development of this BA. The following information was excerpted from Myers *et al.* (1998):

> Chinook salmon mature between 2 and 6+ years of age (Myers et al., 1998). Fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey, 1991). Post-emergent fry seek out shallow, near-shore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. The optimum temperature range for rearing Chinook salmon fry is 50°F to 55°F (Rich, 1997; Seymour, 1956), fingerlings is 55°F to 60°F (Rich, 1997) and smoltification and seaward migration is 50°F to 55°F (Rich, 1997). Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers et al., 1998). Chinook salmon addressed in this document exhibit an ocean-type life history, and smolts out-migrate predominantly as subyearlings, generally during April through July. Some Chinook salmon return from the ocean to spawn one or more years before full-sized adults return, and are referred to as jacks (males) and jills (females).

Lower Columbia River Chinook Salmon

The Lower Columbia River (LCR) Chinook salmon ESU was listed as threatened under the ESA by NOAA Fisheries on March 24, 1999 (64 FR 14308). The ESU includes all naturally- spawned populations of Chinook salmon in the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River.

Oregon DEQ and USEPA (2002) reported that Celilo Falls, which corresponds to the edge of the drier Columbia Basin Ecosystem and historically may have presented a migration barrier to Chinook salmon at certain times of the year, is the eastern boundary for this ESU. Not included in this ESU are "stream-type" spring-run Chinook salmon found in the Klickitat River (which are considered part of the Mid-Columbia River Spring-Run ESU) or the introduced Carson spring-Chinook salmon strain (Oregon DEQ and USEPA, 2002). "Tule" fall Chinook salmon in the Wind and Little White Salmon Rivers are included in this ESU, but not introduced "upriver bright" fall-Chinook salmon populations in the Wind, White Salmon, and Klickitat Rivers (Oregon DEQ and USEPA, 2002).

LCR Chinook salmon includes both the fall-run and spring-run stocks. The majority of fish migrating through the action area are fall-run. Adults migrating to the Clackamas River may be present in the lower Willamette River starting in August and continuing through November, with peak migration occurring in September and October. Juveniles in this ESU would be expected in the lower Willamette River starting in March, continuing through July, with peaks occurring in April, May and June. Adult fall-run LCR Chinook salmon return to the river in mid-August and spawn within a few weeks (Kostow 1995; Washington Department of Fisheries [WDF] et al., 1993). These fall-run Chinook salmon are often called "tules" and are distinguished by their dark skin coloration and advanced state of maturation at the time of freshwater entry. Tule fall-run Chinook salmon populations may have historically spawned from the mouth of the Columbia River to the Klickitat River (RKm 290). Whatever spawning grounds were accessible to fall-run Chinook salmon on the Klickitat River (below Lyle Falls at RKm 3) would have been inundated following the construction of Bonneville Dam (RKm 243) in 1938 (Bryant, 1994; Hymer et al., 1992; WDF et al., 1993). Tule fall-run Chinook salmon begin the freshwater phase of their return migration in late August and October and the peak-spawning interval does not occur until November (WDF et al., 1993). Tributaries below Willamette Falls historically supported fall Chinook salmon runs. Most of the juveniles from this ESU originate from the Clackamas River (NOAA Fisheries, 2004a).

The majority of fall-run Chinook salmon juveniles emigrate to the ocean as subyearlings (Howell et al., 1985; Hymer et al., 1992; Myers et al., 1998; Olsen et al., 1994; Reimers and Loefell, 1967; WDF et al., 1993). A portion of returning adults whose scales indicate a yearling smolt migration may be the result of extended hatchery-rearing programs rather than of natural, volitional yearling emigration. It is also possible that modifications in the river environment may have altered the duration of freshwater residence. Adults return to tributaries in the lower Columbia River at 3 and 4 years of age.

Threats to Chinook spawning and rearing habitat include habitat loss due to hydropower development, urbanization and other land uses that have reduced the function of riparian and instream habitat. Specific habitat indicators and current conditions are described below in Section 5. Bottom et al. (1985), WDF et al. (1993), and Kostow (1995) provide further reviews of habitat problems. Substantial impacts have occurred in the Lower Willamette Valley, including channelization and diking of rivers, filling and draining of wetlands, removal of riparian vegetation, and pollution (Kostow, 1995).

Upper Willamette River Chinook Salmon

The Upper Willamette River (UWR) Chinook Salmon ESU was listed as threatened under the ESA by NOAA Fisheries on March 24, 1999 (64 FR 14308). This ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon. Fall Chinook salmon above the Willamette Falls were introduced and are not considered part of this ESU.

The following information was excerpted from Oregon DEQ and USEPA (2002):

> Populations in this ESU have an unusual life history that shares features of both the stream and ocean types. Intrabasin transfers have contributed to the homogenization of Willamette River spring-run Chinook salmon stocks; however, Willamette River spring-run Chinook salmon remain one of the most genetically distinctive groups of Chinook salmon in the Columbia River Basin. The geography and ecology of the Willamette Valley is considerably different from surrounding areas (see discussion of the Willamette Valley Ecoregion). Historically, the Willamette Falls offered a narrow temporal window for upriver migration, which may have promoted isolation from other Columbia River stocks.
>
> Habitat blockage and degradation are significant problems in this ESU. Available habitat has been reduced by construction of dams in the Santiam, McKenzie, and Middle Fork Willamette River Basins, and these dams have probably adversely affected remaining production via thermal degradation throughout the basin (Bottom et al., 1985; Kostow, 1995).

The following information was summarized from NOAA Fisheries (2004a):

> This ESU migrates through the Lower Willamette River beginning in March, and complete their migration by the end of July, with the peak between late April and early June. Some adults may hold for periods within the Portland Harbor. Smolts pass through the area from January through June, and from August through December. Subyearling Chinook have been found in the harbor area over longer periods than other species of salmonids, probably because they actively feed during migration. Some juveniles may over-winter in the Lower Willamette River.

The following information was summarized from Oregon DEQ and USEPA (2002):

> Knutsen and Ward (1991) study of the behavior of juvenile salmonids migrating through the Portland Harbor area found that subyearling Chinook salmon appeared to be actively migrating through the area. Even during periods of low flows, juveniles did not spend more than a few days in the harbor area. Information on the migratory behavior of subyearlings Chinook is limited. Subyearling Chinook were found in the harbor area over a longer period than other species or races of salmonids, probably because they actively fed during migration. Electrofishing catches from 1987 indicated that some juveniles might over-winter in the Lower Willamette River (NOAA, 1999).

P-3.1.2 Steelhead (O. mykiss)

Information on life history and biological requirements of steelhead is contained in Busby *et al.* (1996) and was used in development of this BA.

Lower Columbia River Steelhead

The Lower Columbia River (LCR) steelhead ESU was listed as threatened under the ESA on March 19, 1998 (63 FR 13347). This ESU includes all naturally spawned populations of steelhead (and their progeny) in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington (inclusive) and the Willamette and Hood Rivers, Oregon (inclusive). Excluded are steelhead in the Upper Willamette River Basin above Willamette Falls and steelhead from the Little and Big White Salmon Rivers in Washington. This ESU includes both winter and summer runs of steelhead.

The following information was excerpted or summarized from Oregon DEQ and USEPA (2002):

> Steelhead populations in this ESU are of the coastal genetic group (Chapman et al., 1994; Schreck et al., 1986; Reisenbichler et al., 1992) and a number of studies have shown that they are part of a different ancestral lineage than inland steelhead from the Columbia River Basin. Genetic data also show steelhead from this ESU to be distinct from steelhead from the Upper Willamette River and from coastal streams in Oregon and Washington. Recent genetic data from Washington Department of Fish and Wildlife (WDFW) also show clear differences between samples from the Wind, Washougal, and Big White Salmon Rivers and those from the coast of southwest Washington.
>
> This ESU is composed of winter steelhead and summer steelhead. Nonanadromous steelhead co-occur with the anadromous form in Lower Columbia River tributaries; however, the relationship between these forms in this geographic area is unclear. Life history attributes for steelhead within this ESU appear to be similar to those of other west coast steelhead.
>
> Significant habitat blockages resulted from dams on the Sandy River, and minor blockages (such as impassable culverts) are likely throughout the region. Habitat problems for most stocks in this ESU are similar to those in adjacent coastal ESUs. Clearcut logging has been extensive throughout most watersheds in this area, and urbanization is a substantial concern in the Portland and Vancouver areas. Because of their limited distribution in upper tributaries, summer steelhead appear to be at more risk from habitat degradation than are winter steelhead. Hatchery fish are widespread and escape to spawn naturally throughout the region. The major present threat to genetic integrity for steelhead in this ESU comes from past and present hatchery practices.

The following information was excerpted or summarized from NOAA Fisheries (2004a):

> LCR steelhead move through the Lower Willamette throughout the year. Peak adult movement is expected from late April through May. Out migration of juveniles starts in April, peaks in May, and is complete by mid-July. Most steelhead smolts move downriver through the action area in less than a day, and are predominately 2+ years of age.

Upper Willamette River Steelhead

The Upper Willamette River (UWR) steelhead was listed as threatened under the ESA by NOAA Fisheries on March 25, 1999 (64 FR 14517). This ESU includes all naturally spawned populations of winter-run steelhead in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River, inclusive.

The following information was excerpted from Oregon DEQ and USEPA (2002):

> The native steelhead of this basin are late-migrating winter steelhead, entering fresh water primarily in March and April (Howell et al., 1985), whereas most other populations of west coast winter steelhead enter fresh water beginning in November or December.

> Substantial habitat blockages resulted from Detroit, Big Cliff and Green Peter Dams on the Santiam River, and flood control dams on the main stem Willamette. Other blockages such as smaller dams or impassable culverts are likely throughout the region. Habitat problems for most stocks in this ESU are similar to those in adjacent coastal ESUs. Clearcut logging has been common throughout most watersheds in this area, and there is extensive urbanization in the Willamette Valley. Bottom et al. (1985) identified specific factors affecting salmon habitat in various areas of Oregon, including streamflow and temperature problems, riparian habitat losses and instream habitat problems. Within the Willamette Valley, they noted that temperatures and streamflows reach critical levels for salmonids in places where there are significant water withdrawals or removal of streamside vegetation. Bottom (1985) also noted the following: loss of riparian vegetation has resulted from agricultural practices and rural and urban development; that bank erosion is severe in several areas of the basin; and, that splash dams, debris removal and stream channelization have caused long-term damage to salmonid habitats.

Adult UWR steelhead could be expected in the lower Willamette River from January through mid-May (NOAA Fisheries, 2004a). Smolts would be present from March through mid-July, with peaks occurring in May. Spawning occurs upstream/outside of the action area. Juvenile steelhead have been observed to actively migrate through the Portland Harbor area, spending less time in the area than other juvenile salmonids (Knutsen and Ward, 1991).

P-3.1.3 Chum Salmon (O. keta)

Information on life history and biological requirements of chum salmon is contained in Johnson et al. (1997) and was used in development of this BA. The following information is summarized from Johnson et al. (1997):

> Historically, chum salmon were distributed throughout the coastal regions of western Canada and the United States, as far south as Monterey Bay, California. Presently, major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast. Small spawning populations of chum salmon are regularly found as far south as the LCR and Tillamook Bay. The hydrology and flow patterns of rivers draining into the lower Columbia River are similar to those of coastal rivers immediately north and south of the Columbia River, with a single peak in December or January and relatively low flows in summer and fall.
>
> Chum salmon are believed to spawn primarily in the lower reaches of rivers because they usually show little persistence in surmounting river blockages and falls. However, in some systems, such as the Skagit River, Washington, chum salmon routinely migrate over long distances upstream (at least 170 km in the Skagit River).
>
> Alterations and loss of freshwater habitat for salmonids have been extensively documented in many regions, especially in urban areas or habitat associated with construction of large dams. In the last 25 years, a major issue in "stream restoration" has been the role that large woody debris (LWD) plays in creating and maintaining Pacific salmon spawning and rearing habitat. Descriptions of pre-development conditions of rivers in Washington and Oregon that had abundant salmonid populations suggest that even big rivers had large amounts of instream LWD, which not only completely blocked most rivers to navigation but also contributed significantly to trapping sediments and nutrients, impounding water, and creating many side channels and sloughs (Sedell and Luchessa, 1982; Sedell and Frogatt, 1984). Many

> streams consisted of a network of sloughs, islands, and beaver ponds with no main channel. For example, portions of the Willamette River reportedly flowed in five separate channels, and many coastal Oregon rivers were so filled with logjams and snags that early explorers could not ascend them. Large woody debris, snags, and instream vegetation similarly blocked most rivers in coastal Washington and Puget Sound.

Columbia River Chum Salmon

The Columbia River (CR) Chum salmon was listed as threatened under the ESA by NOAA Fisheries on March 25, 1999. This ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon. In the Columbia River Basin, there are reports that chum salmon may historically have spawned in the Umatilla and Walla Walla Rivers, more than 500 km from the sea (Nehlsen et al., 1991). However, these fish would have had to pass Celilo Falls, a web of rapids and cascades, which presumably was passable by chum salmon only at high waterflows. Chum salmon are limited to tributaries below Bonneville Dam, with the majority of fish spawning on the Washington side of the Columbia River. Chum salmon have been reported in October in the Washougal, Lewis, Kalama, and Cowlitz Rivers in Washington and to the Sandy River in Oregon (Salo, 1991). ODFW cited 25 locations in that state where chum salmon spawn in the LCR, but run times for these fish are unavailable (Kostow, 1995).

The effects of the mainstem Columbia River hydropower system have probably been more severe for chum salmon than for other salmon species. Bonneville Dam presumably continues to impede recovery of upriver populations. Substantial habitat loss in the Columbia River estuary and associated areas presumably was an important factor in the decline and also represents a significant continuing risk for this ESU.

NOAA Fisheries (2004a) included the following information:

> Adult chum salmon may occur near the mouth of the Willamette River during their upstream migration from late September through December. They do not spawn in the Willamette or tributaries. Chum salmon fry may move into the Lower Willamette River during incoming tides, and feed on organisms within the action area for short periods.

Oregon DEQ and USEPA (2002) indicated that there is no record of chum salmon use of habitat within the vicinity of the action area.

P-3.1.4 Coho Salmon (O. kisutch)

General life history information and biological requirements of coho salmon have been described in various documents (CDFG, 1994; Hassler, 1987; Sandercock, 1991; Shapovalov, 1954; Weitkamp et al., 1995) These documents were used as information sources in developing this BA. Available historical and most recent published coho salmon abundance information are summarized in the NOAA Fisheries coast-wide status review (Weitkamp et al., 1995).

Adult coho salmon typically enter rivers between September and February. Spawning occurs from November to January (Hassler, 1987), but occasionally as late as February or March (Weitkamp et al., 1995). Coho salmon eggs incubate for 35-50 days between November and March. Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Fry start emerging from the gravel two to three weeks after hatching and move into shallow areas with vegetative or other cover. As fry grow larger, they disperse up or downstream. In summer, coho salmon fry prefer pools or other slower velocity areas such as alcoves, with woody debris or overhanging vegetation. Juvenile coho salmon over-winter in slow water habitat with cover as well. Juveniles may rear in fresh water for up to 15 months then migrate to the ocean as smolts from March to June (Weitkamp et al., 1995). Coho salmon adults typically spend two years in the ocean before returning to their natal streams to spawn as three-year olds.

Lower Columbia River Coho Salmon

On June 24, 2004, NOAA Fisheries proposed the LCR coho salmon as threatened under the ESA (69 FR 33102). The ESU includes all naturally spawned populations of coho salmon from Columbia River tributaries below the Klickitat River on the Washington side and below the Deschutes River on the Oregon side, including the Willamette River as far upriver as Willamette Falls.

The following information is summarized from Johnson et al. (1991) and Weitkamp et al. (1995):

> It is clear from the historic record that natural production of coho salmon is now substantially below historical levels, although this decline has been offset by hatchery production in many areas. Decline in the natural population is likely related to freshwater and estuarine habitats degradation. The ODFW conducts annual coho salmon spawning surveys in the LCR Basin (Fennell, 1993). These surveys indicated that natural spawning of coho salmon in this region declined precipitously in the early 1970s and has remained at extremely low levels.
>
> The Clackamas River, a tributary of the Willamette River, may support a native run of coho salmon that is a remnant run of fish native to the LCR Basin (Cramer and Cramer, 1994). Cramer and Cramer concluded that production of the native population is depressed due to a variety of factors. They further concluded that under current harvest rates, the population is likely to remain stable but is vulnerable to over harvest. Johnson et al. (1991) briefly reviewed abundance data for this population and, although they concluded that it had a low risk of extinction if population parameters remained stable, they recommended close monitoring of the population.
>
> The Clackamas River produces moderate numbers of natural coho salmon. The Clackamas River late-run coho salmon population is relatively stable under present conditions, but is depressed and vulnerable to over harvest. Its small geographic range and low abundance make it particularly vulnerable to environmental fluctuations and catastrophes, so this population may be at risk of extinction despite relatively stable spawning escapements in the recent past.

Recent status reviews of this ESU indicate that it is dominated by hatchery-origin spawners, but there are some potential pockets of natural production. NOAA Fisheries (2004a) reported that coho salmon may use small pockets of good habitat in the lower Columbia in greater numbers than expected.

Weitkamp et al. (1995) show coho salmon peak river entry timing for the Columbia River as late September-mid-October. Oregon DEQ and USEPA (2002) included that coho salmon migrate up the Willamette from late August through early November, with peak numbers beginning in mid- to late September, and with spawning occurring from September-December. Port of Portland and Ellis Ecological Services (2004a) show LCR coho salmon run timing through the lower Willamette River occurring August-March, with peak run timing occurring in mid-October through November with a second peak in February. Port of Portland and Ellis Ecological

Services (2004a) showed coho salmon juvenile emigration occurring April-June, with peak emigration of juveniles occurring mid to end of May.

P-3.1.5 Pacific Salmonid Use of the Action Area

ODFW (2005) evaluated aquatic habitat and biotic communities in the lower Willamette River and assessed salmonid use of nearshore habitat, outmigration timing, size structure, growth, migration rate and residence time. Outmigration periods for Chinook salmon were long. The presence of juvenile fish increased in late autumn and persisted into the next summer. Juvenile salmonids were present in every month sampled from May 2000 through July 2003. Winter and spring were the periods of greatest abundance, though different races (spring and fall), size classes, and stocks may have confounded the ability to completely assess timing. However, numbers of fish were significantly reduced in the summer compared to the winter. Coho salmon and steelhead were present only during winter and spring. ODFW (2005) observed that fish moved rather quickly through the study area, though the median migration rate for coho salmon (4.6 km/d) was significantly slower then for Chinook salmon (11.3 km/d) or steelhead (12.5 km/d). Median residence times in the study area were 8.7 days for coho salmon, 3.4 days for Chinook salmon and 2.5 days for steelhead. Approximately 76% of the Chinook salmon recoveries occurred offshore, thus tagged Chinook were not highly associated with nearshore areas. Coho salmon were found near shore more often (43%) and appeared to prefer beaches, and avoid riprap and artificial fill. Steelhead were rarely associated with nearshore areas. Overall, ODFW (2005) found little evidence to suggest nearshore habitat as it currently exists is a critical factor affecting yearling salmonids, and generally agreed with prior studies, which concluded waterway developments in the Lower Willamette River presents few risks to juvenile salmonids, but effects of development are incompletely explored. However, the Lower Willamette River is more than simply a migration corridor as the study (ODF 2005) indicated that Chinook salmon feed and grow during their outmigration and coho salmon also feed extensively on aquatic invertebrates and were appeared to prefer beach areas.

In summary, the action area does provide habitat for juvenile salmonids. However, 76% of Chinook salmon juvenile recoveries were offshore and steelhead were rarely associated with nearshore areas. Coho salmon were found in nearshore areas more often. Thus, relative to the Removal Action Area, LCR and UWR Chinook salmon juveniles and LCR and UWR steelhead juveniles primarily utilize offshore areas that would be treated by dredging as described below. LCR coho salmon prefer shallow beach areas, and these areas may be treated through capping and MNR. Slip 1, where the proposed CDF would be located, does not provide preferred shallow beach habitat. Oregon DEQ and USEPA (2002) indicated that there is no record of CR chum salmon use of habitat within the vicinity of the action area.

P-3.2 Formal Habitat Designations

Critical Habitat

The ESA defines critical habitat under section 3(5)(A) as the specific areas within the geographical area occupied by the species, at the time it is listed on which are found those physical or biological features that are essential to the conservation of the species and which require special management consideration or protection; and specific areas outside the geographical area occupied by the species at the time it is listed…upon determination by the Secretary that such areas are essential for the conservation of the species. Once critical habitat is designated, Section 7 of the ESA requires federal agencies to ensure they do not fund, authorize or carry out any action that will destroy or adversely modify that habitat. This requirement is in addition to the section 7 requirement that federal agencies ensure their actions do not jeopardize the continued existence of listed species.

On December 14, 2004, NOAA Fisheries issued a proposed rule (69 FR 74572) to designate critical habitat for 13 ESUs of Pacific salmon and steelhead including for the following ESUs that are the subject of this BA: 1) LCR Chinook salmon; 2) UWR Chinook salmon; 3) CR chum salmon; 4) LCR steelhead; and 5) UWR steelhead. The proposed rule proposes to designate specific areas of critical habitat for these ESUs.

In the proposed rule (69 FR 74572), NOAA Fisheries proposes to be precise about the geographical area included in the designations. Specifically, the current mapping identifies only those occupied stream reaches where the species has been observed (and potentially where they are presumed to be). Occupied reaches are aggregated at the fifth field hydrologic unit scale.

In determining what areas are critical habitat, NOAA Fisheries is required to "consider those physical or biological features that are essential for the conservation of a given species…, including space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, and rearing of offspring; and habitats that are protected from disturbance or are representative of the historical geographical and ecological distribution of a species." The regulations [at 50 CFR 424.12(b)] further direct NOAA Fisheries to "focus on the principal biological or physical constituent elements (PCE) as including, but not limited to: roost sites, nesting grounds, spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, host species or plant pollinator, geological formation, vegetation type, tide, and specific soil types." An area lacking PCEs may not be designated in the hope it will acquire PCEs in the future. NOAA Fisheries determined that PCEs include sites essential to support one or more life stages of the ESUs including freshwater spawning and rearing sites, migration corridors and estuarine areas. NOAA Fisheries assembled Critical Habitat Analytical Review Teams (Team) to determine whether a stream reach occupied by the ESUs contain PCEs.

The Lower Columbia River corridor was determined by the Team to be of high conservation value to the LCR Chinook salmon ESU (contains PCEs), as it connects every watershed and population within the ESU with the Ocean and is used by rearing/migrating juveniles and migrating adults. The Team also concluded that the Lower Willamette/Columbia River corridor was of high conservation value to the UWR Chinook salmon ESU as this corridor connects every watershed and population with the ocean and is used by rearing/migrating juveniles and migrating adults (thus, contains rearing/migration PCEs). Similar conclusions were included for steelhead ESUs.

The extent to which the Removal Action Area may be utilized by migrating adult salmonids and rearing/migrating juvenile salmonids is not known. All habitat indicators (with the exception of substrate quality, which does not include contamination) in the Lower Willamette River are either at risk or not properly functioning. The PCEs identified by NOAA Fisheries include sites essential to support one or more life stages of the ESUs and these sites contain physical or biological features essential to the conservation of the ESU. NOAA Fisheries identified types of sites and features associated with them including freshwater rearing and migration corridors. Freshwater rearing sites were those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, etc. While the Lower Willamette River contains migration and rearing PCEs, it is unknown whether the Removal Action Area proper contains PCEs due to past and ongoing development and industrial use of the area, including past channel modifications and other changes and impacts that have resulted in poor quality rearing and migration habitat. These changes have resulted in loss of PCEs and degradation of the area in terms of its value as migratory, resting and feeding habitat (refer to the environmental baseline section of the BA).

The ESUs considered in this BA share many of the same river reaches and have similar life history characteristics and requirements (and share the same PCEs). Although the final designations for critical habitat have not been issued, effects to critical habitat are analyzed herein because the critical habitat designations have been proposed, and in anticipation of final designations that will be forthcoming in 2005. Where the BA refers to "habitat", by definition, includes reference to "critical habitat."

For terrestrial species evaluated in this BA (bald eagle, streaked-horned lark, or yellow-billed cuckoo), no critical habitat has been designated.

Essential Fish Habitat

Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Act (MSA) require heightened consideration of fish habitat in resource management decisions. The Pacific Fishery Management Council designated EFH for groundfish (PFMC, 1998a), coastal pelagic species (PFMC, 1998b), and Chinook salmon, coho salmon and Puget Sound pink salmon (PFMC, 1999). The action area includes areas designated as EFH for various life-history stages of coho salmon, Chinook salmon, and starry flounder. EFH is defined in Section 3 of the MSA as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." NOAA Fisheries interprets EFH to include aquatic areas and their associated physical, chemical and biological properties used by fish that are necessary to support a sustainable fishery and the contribution of the managed species to a healthy ecosystem. The MSA and its implementing regulations [at 50 CFR 600.92(j)] require that before a federal agency may authorize, fund or carry out any action that may adversely effect EFH, it must consult with NOAA Fisheries. The purpose of the consultation is to develop conservation recommendations that address reasonably foreseeable adverse effects to EFH. References to "habitat" herein include reference to EFH, since by definition "habitat" for Pacific Salmonids is the functional equivalent to EFH.

P-3.3 Wildlife Species

P-3.3.1 Bald Eagle (Haliaeetus leucocephalus)

Listing status for bald eagles was described in Port of Portland and Ellis Ecological Services (2004a) and is cited below:

> Bald eagles were listed as endangered in the contiguous United States under the ESA on March 6, 1967 (32 FR 4001). The population in the Pacific Northwest was later down-listed on February 14, 1978 to threatened. Bald eagles in the remaining states were subsequently downlisted to threatened on July 12, 1995 (60 FR 36000). Bald eagle populations have rebounded considerably within the last few years, with nearly all recovery goals met for Oregon, Washington, and other regions of the country. On July 6, 1999 the USFWS proposed de-listing bald eagles from the ESA. Bald eagles and golden eagles are and will continue to be protected under the Bald Eagle and Golden Eagle Protection Act of 1940 (as amended) and the Migratory Bird Treaty Act.

Bald eagles occur throughout the United States and Canada, typically along the shores of saltwater, and freshwater lakes and rivers. The bald eagle is especially common in areas with large expanses of aquatic habitat, including Florida, Chesapeake Bay, Maine, and the Maritime Provinces of Canada, the Great Lakes and lake regions of Ontario, Manitoba, and Saskatchewan, northern California, Oregon, Washington, and coastal British Columbia and Alaska (http://ecos.fws.gov/docs/life_histories/B008.html). In Oregon, breeding territories are located in predominantly coniferous, uneven-aged stands with old-growth components (Oregon DEQ and USEPA, 2002).

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 (Oregon DEQ and USEPA, 2002). The breeding range of the bald eagle is associated with aquatic habitats (coastal areas, river, lakes, and reservoirs) with forested shorelines or cliffs in North America. Throughout their range, they select large, super-canopy roost trees that are open and accessible, mostly conifers. Bald eagles typically build nests in mature old-growth trees, which are generally used in successive years. In Oregon, 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 (Rodrick and Milner, 1991). On the Columbia River, Oregon, breeding home ranges averaged 21.6 square kilometers (Garrett et al., 1993).

Oregon DEQ and USEPA 2002 summarized feeding by bald eagles. The excerpt of that discussion is provided below:

> 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 (Rodrick and Milner, 1991). On the Willamette River, the most likely food resource items are gulls, waterfowl, and fish.

The current limiting factor for bald eagles is largely the loss of nesting habitat due to development along the coast and near inland rivers and waterways. The NatureServe Comprehensive Report (2004)[1] for bald eagles suggests that the major threats include habitat loss, disturbance by humans, biocide contamination, decreasing food supply, and illegal shooting (Evans, 1982; Green, 1985; Herkert, 1992). The report goes on to suggest that eagles are generally susceptible to human intrusion, but "show a high degree of adaptability and tolerance if the human activity is not directed toward them" (Beebe, 1974). However, chronic disturbance results in disuse of areas by eagles (Fraser, 1985).

Both juvenile and adult bald eagles are present along the lower Willamette River throughout the year (Port of Portland and Ellis Ecological Services, 2004a). During the winter, bald eagles commune on Sauvie Island located at the confluence of the Willamette River with the Columbia River. The report goes on to state that there are two known bald eagle communal winter night roosts in the vicinity of the Portland metropolitan area,

[1] NatureServe is a joint independent organization formed by The Nature Conservancy and the Natural Heritage Network. (http://www.natureserve.org/).

including: one in the vicinity of Vancouver Lake in Clark County, Washington and the other south of Salmon Creek in North Vancouver.

The McCormick and Baxter BA (Oregon DEQ and USEPA, 2002) reported that no eagle nest were present within two miles of the project site. However, further downstream in the vicinity of Terminal 4, the BA developed by the Port of Portland and Ellis Ecological Services (2004a) reports that an eagle nest site is located at Smith Lake, about 1.9 miles east of the Terminal 4 project area. September 2003 surveys occurred after the breeding season and no young were observed. Historic nest sites were also identified, near Belle Vue Point on Sauvie Island, near Blurock Landing in Washington, and Ross Island. All three nesting pairs successfully fledged two eagles in 2001 (Isaacs and Anthony, 2003, as cited in Port of Portland and Ellis Ecological Services, 2004a).

P-3.3.2 Yellow-Billed Cuckoo

Yellow-billed cuckoo was petitioned as a species deserving protection under the ESA in 1986 for the states of California, Washington, Oregon, Idaho, and Nevada (Manolis et al., 1986). The USFWS published a 12-month finding on December 29, 1988 (53 FR 52746), stating that the petitioned action was not warranted, finding that the petitioned area did not encompass either a distinct subspecies or a distinct population segment. A second petition was filed in February 1998 to list the species as a distinct population segment for the Western US. USFWS initiated a status review February 17, 2000 to determine if the petitioned action (listing as endangered) was warranted (USFWS, 2000). A notice of 12-month petition finding was issued in July 2001 that stated that the petitioned action is warranted, but precluded by higher priority listing actions. The yellow-billed cuckoo was categorized as a candidate species pending further review of higher priority species (May 20, 2004; 69 FR 29121).

The yellow-billed cuckoo's range and population numbers have declined substantially across much of the western United States over the past 50 years. Based on historic accounts, the species was widespread and locally common in California and Arizona, locally common in a few river reaches in New Mexico, common very locally in Oregon and Washington, generally local and uncommon in scattered drainages of the arid and semiarid portions of western Colorado, western Wyoming, Idaho, Nevada, and Utah, and probably uncommon and very local in British Columbia (July 25, 2001; 66 FR 38611). In the Pacific Northwest, the species was formerly fairly common locally in willow bottoms along Willamette and Columbia Rivers in Oregon, and in the Puget Sound lowlands and along the Lower Columbia River in Washington (Gabrielson and Jewett, 1940; Jewett et al., 1953; Marshall, 1969; Roberson, 1980).

Western states populations' of yellow-billed cuckoo have nearly completely collapsed. These birds need large riparian forests, especially those with cottonwood overstories and willow understories; such formerly extensive habitats are largely vanished from the metro area at present, and where cottonwood is present it tends to be invaded by nonnative blackberries rather than willow. Habitat loss is the most likely reason for their decline (Metro, 2002a; 2002b).

Habitat and ecological information for yellow-billed cuckoo is presented in the Federal Register (Vol 66, No. 143) and is summarized in the following discussion. Western yellow-billed cuckoos breed in large blocks of riparian habitats (particularly woodlands with cottonwoods and willows). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (Laymon et al., 1993).

Clutch size is usually two or three eggs, and development of the young are very rapid, with a breeding cycle of 17 days from egg-laying to fledging of young. Although yellow-billed cuckoos usually raise their own young, they are facultative brood parasites, occasionally laying eggs in the nests of other yellow-billed cuckoos or of other bird species (Hughes, 1997). Western yellow-billed cuckoos appear to require large blocks of riparian habitat for nesting. Home range size of nesting pairs varies from 10 ha along the Sacramento River in California to 40 ha. Nesting densities ranging from 1 to 15 pairs per 40 ha (99 acres) were estimated in a New Mexico study (Howe, 1986), and three plots in Arizona had densities ranging of 8.2, 19.8, and 26.5 pairs per 40 ha (99 acres) (Hughes, 1999). Nesting west of the Continental Divide occurs almost exclusively close to water, and biologists have hypothesized that the species may be restricted to nesting in moist river bottoms in the West because of humidity requirements for successful hatching and rearing of young (Hamilton and Hamilton, 1965; Rosenberg et al., 1991). Nesting peaks later (mid-June through August) than in most co-occurring bird species, and may be triggered by an abundance of the cicadas, katydids, caterpillars, or other large prey which form the bulk of the species' diet (Hamilton and Hamilton, 1965; Rosenberg et al., 1982). The species is inconspicuous on its breeding range, except when calling to attract or to contact mates.

The BA for Terminal 4 Slip 3 (Port of Portland and Ellis Ecological Services, 2004a) queried the Oregon Natural Heritage Information Center for information on the observed presence of species near the project area. No occurrences of yellow-billed cuckoo were reported. Yellow-billed Cuckoos were formerly common along the Columbia River west of the cascades, but they are extirpated from the Portland metropolitan area now (Metro 2002a; 2002b).

P-3.3.3 Streaked Horned Lark (Eremophilia alpestris strigata)

Streaked horned lark was formerly a common nesting species in grasslands and prairies west of the Cascade Mountains from southern British Columbia, through Washington and Oregon. In the 1920's, the streaked horned lark was considered one of Oregon's "characteristic" birds and was fairly common up to the 1970's. It is now extirpated from the Umpqua and Roque valleys and occurs only in scattered sites in the Willamette Valley. The state's entire population is about 200 pairs (CBD et al., 2002).

The October 30, 2001, Federal Register (66 FR 54808) provided the following for streaked horned lark.

> The streaked horned lark is considered rare. Currently, it is estimated that fewer than 200 breeding pairs remain in Oregon. In Washington, it has been extirpated from north Puget Sound and the San Juan Islands, and less than 100 pairs remain in south Puget Sound and along the coast. The greatest threat to the streaked horned lark is loss of habitat. Biologists estimate that less than 1 percent of native grassland and savanna remains. Conversion of grassland to other uses, such as agriculture and homes, and the encroachment of nonnative plants, have been the primary factors contributing to the species' decline. Because these threats are of a high magnitude but are non-imminent, the USFWS assigned a lower priority number to this subspecies.

A petition to list the streaked horned lark was submitted to the USFWS in December 2002. As of the May 20, 2004 (69 FR 29121) the USFWS has not altered the candidacy or ranking status for this species.

CBD et al. (2002) summarized streaked horned lark habitat as follows:

> The streaked horned lark breeds in short herbaceous vegetation (< 30 cm tall), a relatively high percentage of bare ground, patches of sparsely vegetated areas interspersed with more densely vegetated patches, and an absence of woody vegetation (Altman, 1999). The primary native habitat for the streaked horned lark was gravely, well drained prairie (e.g., Dawson and Bowles, 1909; Rathburn, 1911, personal communication cited in Bent, 1942), a highly endangered habitat in Washington and Oregon (Dunn and Ewing, 1997; Rogers, 1999a). To a lesser extent, it uses seasonal mudflats.

As indicated above, the primary limiting factor for this species is the loss of nesting habitats, primarily comprised of short grasslands with interspersed bare ground.

Portland Metro's Riparian Corridor and Wildlife Habitat Inventories (Metro, 2002a) summarized the following with respect to the presence of streaked horned lark in the Portland Metro area.

> Streaked horned larks are grassland obligates, and the nearly complete loss of native grasslands in the Portland Metropolitan area is the most likely reason for their decline here. They were formerly very common breeders in western Oregon, but are now severely depleted in population numbers and are virtually extirpated as a breeding species in the metro region; a few do breed here in very specific areas, and a few also winter here. The sensitive status only applies to breeding populations of this subspecies. These birds need sparsely vegetated open fields, and don't mind inhabiting disturbed areas such as overgrazed pastures; they dig a nest cavity in dry ground with sparse vegetation. Urban development and changes in farming practices are cited as likely reasons for this species' decline; for example, many former pastures are now producing grass seeds, and high nest mortality may result from farm practices such as mowing.

P-4. *Environmental Baseline*

This section describes the existing conditions of the action area, which includes the effects of past and ongoing human and natural factors leading to the current status of the species, their habitat and ecosystems. The biological requirements of salmonids have been defined above in Section 3.0 and indicators of habitat quality for Pacific salmonid ESUs and other aquatic species are defined below in terms of the concept of properly functioning condition (PFC). PFC is the sustained presence of natural habitat-forming processes in a watershed that are necessary for long-term survival of the species. NOAA Fisheries (1996) has developed an analytic methodology using the concept of PFC to help determine the environmental effects of a given action by describing an action's effects on PFC. This includes use of the *Matrix of Pathways and Indicators* (MPI) (NOAA Fisheries, 1996), which represents six conceptual groups (e.g. water quality, habitat access, habitat elements, etc.) and 18 habitat indicators (temperature, sediment, chemical contamination, etc.).

BBL (2004a) summarized general local conditions as follows:

> The Lower Willamette River from the Portland area to the confluence with the Columbia River is characterized by a maintained navigation channel and shoreline that is extensively modified for industrial and commercial uses. The modification has resulted in deep (>20 ft CRD [Columbia River Datum]) open-water habitats in navigation areas, including much of Terminal 4. Such deep-water habitat generally provides feeding habitat for fish and wildlife that feed primarily on water-column species. Adjacent to the deep-water areas are generally shallower areas (<20 ft CRD), usually adjacent to shorelines or other areas outside the navigation channel.
>
> The shallower areas generally provide more opportunity for foraging by wading birds and semiaquatic mammals, as well as for aquatic life, including juvenile salmonids, that feeds preferentially in shallower, slack-water areas. Benthic habitats in the river can be generally divided into three types: (1) unconsolidated sediments (sands and silts) in the deeper water and lower channel slopes; (2) unconsolidated sediments (sands and silts) in shallower areas; and (3) developed under-water structures such as rock riprap, sheet pile, and bulkheads. All three habitat types can be found at the Terminal 4 Removal Action Area. The deeper habitat with typically unconsolidated sediment tends to be in the center of Slips 1 and 3 and the outer portions of Wheeler Bay.
>
> Shallow-water areas are found at the margins of the slips and Wheeler Bay, under docks and piers, and in uncovered areas. The shallow areas also typically contain structures that include concrete and wooden pilings, riprap, and other non-native surfaces.

The following sections provide more detail on the characteristics of the biological community and key indicators of aquatic habitat quality.

P-4.1 General Information on Biological Communities in the Action Area

The City of Portland (2004) described the following general characteristics for aquatic biota:

> The aquatic biota of the lower Willamette River have changed significantly from historical conditions. Extirpations of sensitive species have occurred, and introductions of nonnative species have resulted in

increased competition for food and habitat for native species. The existing fish community in the Lower Willamette River consists of warm-water, cool-water and cold-water fish. There are several listed salmonid ESUs that use the Lower Willamette River. At least 33 other native and introduced species of both warm-water and cool-water fish inhabit the river (ODFW, 1994).

The following discussion summarizes the available information on the biological characteristics of the Terminal 4 Removal Action Area and the Willamette River in the vicinity of Terminal 4 as described in the Terminal 4 EE/CA work plan (BBL, 2005).

Farr and Ward (1993) sampled extensively in the Lower Willamette River to determine the fish species present. They identified 39 species, 19 of which were exotic. They identified species included federally listed salmon species, white sturgeon, northern pikeminnow, smallmouth bass, and peamouth. During sampling conducted in 2002 to support the Portland Harbor RI/FS, reticulated and prickly sculpin, common carp, and largescale sucker were collected from Terminal 4 for tissue analysis. Pacific lampreys are a species of concern for investigations in the Lower Willamette River. Surveys for larval ammocoetes were conducted in the Portland Harbor, although not specifically at Terminal 4. No larval or adult lampreys were identified in the harbor during the survey, but additional surveys of greater scope and frequency are needed to confirm the presence or absence of lamprey in the harbor and Terminal 4.

The Terminal 4 Slip 3 BA (Port of Portland and Ellis Ecological Services, 2004a) described occurrences of non-salmonid fish species (refer to Table P-4 for a list of fish species collected) and benthic invertebrates in or near the project area. Ellis Ecological Services (EES, 2003) indicated that in its fish tissue survey of the Lower Willamette River, threespine stickleback, pacific sculpin, yellow perch, and smallmouth bass were the most abundant fish species collected. ODFW (2003) surveys near the seawall immediately upstream of Slip 3 showed low catch rates of juvenile salmonids in the vicinity of the project area. However, seawall habitat may not be representative of habitat in the project area. Habitat in the Slip areas may be utilized by juveniles as these areas may provide velocity refuge during higher flow events as well as feeding opportunities. No minnows, sunfishes, or suckers were collected at site 048E, but catch per unit effort (CPUE) of predator fishes was higher than any other site (1.0 fish/effort). Overall, the study identified 37 different fish species from 15 different families in the Lower Willamette River. Non-native species included 17 species from seven different families. Unidentified salmon and trout composed the greatest proportion of the catch (22.4%), followed by American shad (15.6%), Chinook salmon (14.6%), unidentified suckers (13.1%), threespine stickleback (8.2%) and peamouth chub (7.2%). Species rarely encountered included cutthroat trout (n = 3), western mosquitofish (n = 3), sockeye salmon (n = 3), grass carp (n = 2), and warmouth (n = 1). Species collected as part of these studies are presented in Table P-4.

The Terminal 4 Slip 3 BA described benthic macroinvertebrates and zooplankton known to be present in the Lower Willamette River, including: oligochaetes, mysid shrimp, the amphipod *Corophium salmonis*, chironomid (midge) larvae, crayfish, mollusks, several species of cladocera, copepods, and hydracarina (water mites), and mayflies.

Upland habitat is limited because of surrounding industrial and marine facilities. Vegetated, shallow beach areas are located at the head of Slip 1 and Slip 3 and along much of the Wheeler Bay shoreline. In addition, a shallow cove area with beach shoreline is located just downstream from the mouth of Slip 1. Some revegetation has been conducted in areas at the upstream side of Slip 3. Although habitats exist in Terminal 4, the quality of habitat is reduced by industrial activities and developments. This is especially true for Slip 3, which is one of the Port's busiest berthing areas. Disturbances from ship traffic and the resuspension of sediments by propeller action reduce habitat quality in Slip 3. Far less activity occurs in Slip 1 and Wheeler Bay, but activity in Slip 3 and on adjacent uplands may adversely affect fish and wildlife use in those areas as well.

While not addressed as part of this BA, Oregon Species of Concern for the Lower Willamette River valley are listed in Table P-5.

P-4.2 Aquatic Habitat

This section describes aquatic habitat indicators identified by NOAA Fisheries (1996) for documenting environmental baseline conditions for Pacific salmonids. Although the indicators were developed specifically for documenting baseline conditions and project effects for Pacific salmonids, the indicators also represent important habitat parameters for other aquatic species that may utilize the action area. Pool quality and quantity, and width/depth ratios were not included. The remaining indicators are suited to the type of habitat provided within the action area: adult migration and possibly some rearing habitat for emigrating juveniles. No spawning habitat occurs within the action area.

The following overview was summarized or excerpted from NOAA Fisheries (2004a):

> Just below Willamette Falls, the Willamette River is naturally incised deep into steep bedrock walls that strongly confine the narrow channel. As the river approaches Portland, landform constraints become less severe and the river widens, with conditions increasingly influenced by the Columbia River. Historically, the reduced physical constraints allowed the formation of floodplains and off-channel habitats through Portland, with large off-channel lakes such as Guilds, Doane, and Ramsey (WRI, 2004). This area is a dynamic transitional zone between the two major river systems and the scarcity of off-channel habitat for some distance upstream suggests that the ecological importance of these floodplains was high.
>
> Conditions in the Lower Willamette River have changed dramatically over the last 150 years. The channel has been deepened, narrowed and simplified. Banks have been hardened and lined (WRI, 2004), floodplain and off-channel habitats have been filled and banks have been steepened throughout the length of river within the City of Portland.

As discussed previously, ODFW (2005) conducted fish and habitat surveys in the Lower Willamette River from 2000-2003 to evaluate aquatic habitat and biotic communities, and to look at habitat correlations. Radio-tagged Chinook salmon were not highly associated with nearshore areas; about 76% of the recoveries occurred offshore. Coho salmon were found near shore more often (46%), appeared to prefer beaches and avoided riprap and artificial fill. Steelhead were rarely associated with nearshore areas. Electrofishing catches among habitat types were also compared. ODFW (2005) found no indication that yearling salmonids were associated with specific habitats or groups of habitats, with one exception. In spring, median catch-per-unit-effort for coho salmon were significantly higher at rock outcrops than at other habitats. High catches sometimes occurred more frequently in off-channel areas (alcoves, backwaters, side channels), but were not significantly different from those in the main river channel. During winter, higher catches of juvenile Chinook salmon were often associated with sand substrates, shallow water, and moderate amounts of bank vegetation. Overall, ODFW

(2005) found little evidence to suggest that nearshore habitat, as it currently exists, is a critical factor affecting yearling salmonids.

P-4.2.1 Water Quality

Water quality in the Willamette River is regulated by the State of Oregon through its water quality standards, and enforced by the Oregon DEQ. Water quality standards are both numeric and narrative and are designed to protect designated beneficial uses. The Willamette River from its mouth at the Columbia River to Willamette Falls, has the following designated beneficial uses: Public Domestic Water Supply, Private Domestic Water Supply, Industrial Water Supply, Irrigation, Livestock Watering, Fish & Aquatic Life, Wildlife & Hunting, Fishing, Boating, Water Contact Recreation, Aesthetic Quality, Hydro Power, and Commercial Navigation & Transportation.[2] Table P-7 defines those parameters, which are listed on DEQ's 303(d) list as impairing one or more designated beneficial uses. ODFW (2005) also obtained physical and water quality data in the Lower Willamette River, which is summarized in Table P-6.

Temperature

Temperature criteria vary in Oregon based on the beneficial designated use for a waterbody. The Lower Willamette locations have only a single cold water beneficial use, migration.

The following information was excerpted from Port of Portland and Ellis Ecological Services (2004a):

> DEQ has revised the water quality and temperature standards for the State of Oregon and the standards were recently approved by the USEPA. The DEQ temperature standard for the Lower Willamette River was established to protect cold-water species such as anadromous salmonids. The Willamette River, within the project action area, is identified by the DEQ as providing migration habitat for salmon and steelhead. The temperature standard as described in (OAR 340-041-0028(4)) reads, "Unless superseded by the natural conditions criteria described in section (8) of this rule, or by subsequently adopted site-specific criteria approved by USEPA", the temperature criteria are as follows: (i) The seven-day-average maximum temperature may not exceed 68.0° F (20.0° C); and (ii) Waterbody must have coldwater refugia that is significantly distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the waterbody.
>
> The Lower Willamette River (River Mile 0 to River Mile 24.8) is on the Oregon 303(d) list as water quality limited for temperature during the summer months (Oregon DEQ, 2003b). The listing for the Willamette River was based on data collected by the DEQ at River Mile 7.0 and 13.2 between water years 1986 and 1995 (Oregon DEQ, 2003b).

More recent temperature data, collected by the DEQ Laboratory (Oregon DEQ, 2004) at the Spokane, Portland, and Seattle (SP&S) railroad bridge (River Mile 7.0, 2.3 miles upstream of Terminal 4) were reviewed by the Port of Portland and Ellis Ecological Services (2004a), for the time-period 1994 to 2004. They found that data were consistent with historic data, indicating that mid-summer temperatures continued to exceed the temperature standard. It is therefore concluded from this information that water temperature conditions in the Lower

[2] OAR 340-041-0340, Table 340A

Willamette River are "*not properly functioning*" in terms of salmonid biological requirements during summer months.

Sediment/Turbidity

The following information was summarized or excerpted from Port of Portland and Ellis Ecological Services (2004a):

> NOAA Fisheries' criteria for PFC for sediment are based on requirements in streams where spawning and rearing occur. Although juvenile salmonids may rest and feed in the Lower Willamette River as they emigrate to the ocean, the action area is used primarily as a migration corridor. There is no known spawning in the action area. Sediment conditions in the Willamette River watershed range from excellent in some of the upper tributaries to poor in much of the mainstem river (Altman et al., 1997). Silt loading has been increased over historic levels due to logging, agriculture, road building, urban and suburban development. In the Lower Willamette River, in the vicinity of Terminal 4, the riverbed is predominantly sand and silt (Fuhrer, 1989; Hart Crowser, 2002b). The relationship between salmonid food supply and sediment conditions in the Lower Willamette River is not well understood.
>
> Available turbidity data for the Lower Willamette River were reviewed to describe ambient turbidity levels in the vicinity of Terminal 4. Water quality data obtained by the DEQ Laboratory at the SP&S bridge (RM 7.0) for the period 1995-2000 were reviewed (Oregon DEQ, 2004). The SP&S bridge is referenced here as a control point since it is located approximately 2.3 miles upstream from Terminal 4. Average turbidity levels in the Willamette River tend to be greater in fall and winter. The average monthly turbidity levels for the months of December, January, and February (1995-2000) were 16, 39, and 47 NTUs, respectively. Maximum turbidity levels for December, January and February were 24, 46, and 149 NTUs, respectively. Turbidity levels were generally much lower during the summer and early autumn with average monthly values ranging between 4 and 8 NTUs for the months of July through October. Maximum turbidity levels during these months ranged from 4 to 18 NTUs. Overall, turbidity conditions in the Lower Willamette River appear to fall within the "moderate" turbidity range for a large river. Based on the above information, it is concluded that the Lower Willamette River below Willamette Falls is probably "*at risk*" with regard to sediment/turbidity.

Turbidity measurements were made in Slip 3 over three periods between March 18 and May 17, 2004 as part of the site characterization (BBL, 2004b). The typical minimum optical backscatter (turbidity) measurement during the three deployment periods was 6 NTUs. The instruments also recorded a number of turbidity spikes, ranging between 40 and 300 NTUs, during the trap deployment periods. The average turbidity values recorded by the Acoustic Doppler Current Meter (ADCM) at the Slip 3 East location (inner portion of Slip 3) were between 7.5 and 9 NTUs, while the average values recorded at the Slip 3 West location (outer portion of Slip 3) steadily increased over the study period (9, 15, and 23 NTUs, respectively).

BBL (2004b) measured a number of characteristics during low river flows that affect current velocities and sedimentation within the Terminal 4 Removal Action Area. Ongoing river-induced sedimentation of suspended sediments occurs nearly continuously throughout the Removal Action Area. The periodic redistribution of this material affects long-term sediment accumulation patterns within the slips. Although propeller-induced currents appear to be a more significant factor in sediment transport within the slips than are river-induced currents, the data are not appropriate for modeling potential sediment redistribution.

The Willamette River experiences periodic high turbidity during flood events. Salmonid populations using the Willamette River have evolved under the influence of the seasonal periods of high turbidity, especially during the spring thaw. Although the Willamette River may have had high turbidity levels, the channelization of the Lower Willamette River has changed the character of how sediment interacts in the system. There is no longer an expansive system of braided channels and flood plains to trap and transport sediment throughout the area. Most of the sediment is now discharged directly into the Columbia River. Sediment plumes are likely of longer duration and higher turbidity than during historic conditions.

Sediment quality characteristics of the Removal Action Area are described in detail in the site characterization report (BBL, 2004b) and are also summarized under the Chemical Contaminant indicator below. In summary, the baseline sediment chemical characteristics indicate that sediment concentrations of several inorganic and organic compounds are present which may affect benthic invertebrates, fish, and wildlife.

Hydraulics and sedimentation characteristics of the Removal Action Area are also described in the site characterization report (BBL, 2004b) and include the following: 1) hydraulics within Slips 1 and 3 are affected by variations in river flow, stage, ship-induced currents and to a lesser extent, localized currents from stormwater discharge; 2) river induced currents in the slips are low in velocity compared to river velocity; 3) although river-induced currents have an influence on hydraulics of the Removal Action Area, current velocities in a majority of the Removal Action Area are dominated by propeller-induced currents; 4) propeller-induced currents cause circulation and increased velocities and turbidity levels that extend beyond the paths that ships take in Slip 3; 5) propeller-induced currents influence hydrodynamics and sediment transport in the Removal Action Area; 6) ongoing river-induced sedimentation of suspended sediments occurs nearly continuously throughout the Removal Action Area and periodic redistribution of this material affects long-term sediment accumulation patterns within the slips; and 7) data gathered during the field program are representative of low-flow, low-rainfall conditions and additional data are needed to support characterization of hydraulics and sedimentation in the slips under high-flow, high-rainfall conditions.

Chemical Contamination/Nutrients

Reducing the risk of environmental effects due to contamination in sediments is the primary objective of the Removal Action. Sediment investigations have confirmed the presence of metals and organic contaminants including lead, zinc, PAHs, PCBs, and DDT at potentially ecotoxic concentrations (Hart Crowser, 2000; BBL 2004b). In addition, sediments in some areas of Slip 3 were shown, using laboratory toxicity testing, to be toxic to benthic invertebrates (Hart Crowser, 2000). Toxicity tests have not been conducted for other sediments from the Removal Action Area. Slip 3 currently contains the highest sediment contamination relative to other parts of the Removal Action Area, but significantly elevated concentrations of metals and PAHs have been observed for other areas, especially Slip 1 and Wheeler Bay sediments.

Limited water quality data are available in the immediate vicinity of the action area. Water quality data were collected as part of the RI for Slip 3 (Hart Crowser, 2000). Metals, HPAHs, and phthalates were detected at three sampling locations; but concentrations did not exceed ambient water quality criteria in any of the samples.

The sources of contamination in the action area are, in part, due to historic activities within Terminal 4. However, a wide range of contaminant sources in the river may have also contributed to sediment contamination in the action area. This is particularly relevant for chemicals such as DDT, PCBs, and phthalates for which there are no known specific sources in the action area. Sources include other known sites with contaminated sediments, general anthropogenic sources such as runoff and stormwater outfalls.

P-4.2.2 Habitat Access

Physical Barriers

The Willamette River, from the mouth up to Willamette Falls, is a free flowing river. One main-stem dam (Willamette Falls) and 13 tributary dams largely regulate flows and represent barriers to salmonid migration. Fish passage facilities were constructed at the falls, however, continued loss of adult and juvenile salmonids, delay of upstream migration, and inadequate evaluation of mitigation efforts remain a problem (Port of Portland and Ellis Ecological Services, 2004a). Approximately 400 miles of previously important spawning and rearing areas on the Willamette River are no longer accessible (Foster, 1991), due to major dams on tributaries to the Willamette, undersized culverts and other developments that block access to historically available habitat. Because there are a number of barriers (i.e., impassable dams) to upstream anadromous fish migration in several of the major tributaries to the mainstem Willamette River, this indicator is *at risk*.

P-4.2.3 Habitat Elements

Substrate

Substrate in the Willamette River watershed ranges from gravel/cobble in many of the higher gradient tributaries and upper and mid-sections of the mainstem to sand/silt substrate in much of the Lower Willamette River below Willamette Falls and in several of its low-gradient, valley floor tributaries. Farr and Ward (1993) described the Lower Willamette River as having a steeply sloped, silt and sand bottom. Silt loads to the low gradient reaches of the Lower Willamette River and its valley-floor tributaries have increased over historic levels due to logging, agriculture, road building, and urban and suburban development within the watershed.

The Willamette River is tidally influenced in the project area, and bottom substrates are primarily sand and silt. Grain size analysis measured for surface sediment samples collected for chemical analysis during BBL's (2004b) site characterization indicated that Berth 401 and Slip 1 are generally sandy silts, while for Wheeler Bay and Berth 414 substrates are silty sands. Under pier sediments at Berth 401, Slip 1 and Slip 3 are generally silty sands. Grain sizes were measured in 32 surficial sediment samples distributed throughout Slip 1, Slip 3, Wheeler Bay, Berth 401 and north of Berth 414. Under pier sediment samples were collected at 15 locations. Hart Crowser (2002) characterized sediments in Slip 3 (n= 29) as predominantly silt with a lesser amount of sand and clay. Based on the data collected during both studies, the surficial sediment grain sizes indicate that the substrates are predominantly fine sands and silt in the Removal Action Area.

The action area has no suitable spawning habitat. Thus, although fine sediment and sand are the dominant substrate sizes, substrate composition within the action area is likely similar to historic conditions and is *properly functioning*.

Large Woody Debris

The action area is within an urban setting where riparian vegetation has been lost along with LWD recruitment potential. Channelization of the Willamette River has reduced river meanders, braided channels, and access to the flood plain, which reduced LWD recruitment. Historic logging and stream cleaning practices in riparian zones within tributaries of the Willamette River reduced upstream sources of LWD.

The following information was excerpted from Port of Portland and Ellis Ecological Services (2004a):

> No comprehensive survey data of LWD frequency was found for the Lower Willamette River, at the action area. At Kelly Point Park (located at the mouth of the Willamette River), large diameter black cottonwood trees appear to be prevalent along the shoreline. Numerous, downed, large diameter, decaying cottonwood trees are present along some shoreline areas. Much of the Lower Willamette River has been developed, however, which has reduced the potential for LWD recruitment due to the general absence of mature trees along most of the shoreline. The near-shore habitat comprises only about 15 to 20 percent of the total surface area of the main channel and is heavily industrialized. The majority of the shoreline in the action area consists of riprap, vertical cement walls, and docking facilities. There are also numerous decrepit pilings that blanket the near-shore area. Remnants of natural shoreline are found along the Lower Columbia Slough and across the Willamette River channel on Sauvie Island. Riparian assemblages that exist along the mainstem Willamette River are usually dominated by the following species: Douglas fir, black cottonwood, Oregon white ash, bigleaf maple, red alder and willow. This habitat parameter is considered “not properly functioning” within the lower mainstem of the Willamette River, in the vicinity of Terminal 4.

Based on available information, LWD is considered *not properly functioning* in the Lower Willamette River.

Off-channel Habitat

Off-channel habitat in the Lower Willamette River has been reduced and lost due to channelization, diking, dredging and filling. Remaining off-channel habitat has been degraded by loss of connectivity and other development effects. Thus, off-channel habitat in the action area is *not properly functioning*.

ODFW (2005) found no indication that yearling salmonids were associated with specific habitat or groups of habitat, with one exception. In spring, coho salmon recoveries were higher at rock outcrops compared to other habitats. During winter, higher catches of juvenile Chinook salmon were often associated with sand substrates, shallow water and moderate amounts of bank vegetation. Thus, shallow water habitat with these characteristics may be a key habitat type for juveniles emigrating through the action area . , Many shallow beach habitat areas have been lost or altered due to development over the last 150 years. Thus, the extent of shallow water habitat is considered *not properly functioning* in the Lower Willamette River. The amount of shallow water habitat within each of the five subareas is shown in Table P-9. There is approximately 7.33 acres of shallow water habitat total for the five subareas.

Refugia

High quality refugia habitat (e.g. thermal refuge, velocity refuge, high quality holding and rearing habitat) has been degraded or lost in the Lower Willamette River. Thus, this indicator is considered *not properly functioning* within the action area. Although habitat has been significantly altered by industrial development and high quality refugia is lacking in the Lower Willamette River, Slip areas may provide velocity refuge for salmonids during higher flow events.

P-4.2.4 Channel Conditions and Dynamics

Streambank Condition

Riparian vegetation along the Lower Willamette River has been lost or reduced over much of the action area due to levee development, floodplain development and commercial and industrial development adjacent to the floodplain. Banks have been affected by industrialization with installation of sheet piles, riprap, vertical cement walls, metal debris and docking facilities (Table P-9). In addition, numerous decrepit pilings exist in near-shore areas. Plant communities along streambanks have been drastically altered such that what remains are disturbance species, with few mature trees. Black cottonwood, Oregon white ash, red alder and willow occur in some areas but are largely limited to narrow strips along relatively short stretches of shoreline. Bank protection measures have altered historic streambank conditions. Although these structures provide bank stability, loss of riparian vegetation and natural bank conditions result in streambanks that are considered *not properly functioning*.

Bank erosion was included in the EE/CA (BBL, 2005) as a potential historical and ongoing source of sediment contamination. Bank erosion was observed in the area to the west of Berth 409 and Slip 1 and in Wheeler Bay and may represent a potential source of localized contamination in these areas. However, the EE/CA concluded that bank erosion was not expected to represent a significant source of ongoing area-wide contamination to the Removal Action Area.

Floodplain Connectivity

Floodplain connectivity has been lost or reduced in the action area. The Willamette River has been subjected to flood control projects implemented out of necessity given the locations of infrastructure and development. Thus, this indicator is considered *not properly functioning*.

P-4.2.5 Flow/Hydrology

Peak/Base Flows

The following information was summarized from NOAA Fisheries (2004a):

> Patterns of river flow at Portland are similar to those of the upper basin, which in general reflect seasonal variation in precipitation. Annual minimum flows are typically in August, and rapidly increase from October to December. The highest average flows occur from December to January. Patterns of flow have been changed by water management projects and the presence of dams. There have been markedly higher median flows in the post-Willamette dam period over summer and fall low flow periods. Late summer and early fall flows are currently 2-2.5 times higher than pre-dam conditions. The median flow exhibits sharp peaks during early winter periods, and the dams have reduced the magnitude of peak flood events.

Because patterns of flow have been changed by water management projects and the presence of dams, this indicator is considered *not properly functioning*.

Drainage Network Increase

The lower river basin has an increased drainage network that was designed to convey runoff from developments and roadways. Thus, this indicator is *not properly functioning*.

P-4.2.6 Watershed Conditions

Road Density and Location

Road density in the Lower Willamette River, in the vicinity of the action area is high due to the high population densities and developments. In addition, roads are located in floodplains, in valley bottoms, and affect channel and riparian function. Thus, this indicator is *not properly functioning*.

Disturbance History

The Lower Willamette River channel morphology, streambanks and floodplain areas have been substantially modified by development and urbanization within the channel, floodplains and adjacent areas. These actions have adversely affected the quality and quantity of aquatic habitat in the action area. Both the physical and chemical characteristics of instream and riparian habitat have been substantially altered. Historically, the Willamette River in the Portland area comprised an extensive and interconnected system of active channels, open slack waters, emergent wetlands, riparian forest and adjacent upland forests on hill slopes and Missoula Flood terraces. Connectivity of habitat was high both longitudinally along the river and laterally from the vegetated riverbanks to the upland forests (City of Portland, 2004). Thus, this indicator is *not properly functioning*.

Riparian Reserves

The extent and composition of riparian plant communities along the Lower Willamette River have been substantially altered due to development and urbanization. Riparian functions such as filtering upland sources of sediment and contaminants, shade, organic inputs and recruitment of LWD have been reduced or lost. Thus, this indicator is considered *not properly functioning*.

P-5. *Effects of the Proposed Action*

The following section addresses direct, indirect, interrelated, interdependent and cumulative effects of the proposed action on listed species and applicable critical habitats. Potential direct effects are those effects that occur at or very close to the time of the action. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Interrelated actions are those that are associated with a larger action and depend on the larger action for their justification. Interdependent actions are those with no independent utility apart from the proposed action. Cumulative impacts are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the project action area of the Federal action subject to consultation.

As described in Section 1.0 of the BA, the Removal Action Area encompasses roughly 38 acres, of which Slip 1, Slip 3, and Wheeler Bay make up about 28 acres, while the area from the mouths of the slips to the Harbor Line encompasses approximately 10 acres. Due to the potential for in-water construction activities to affect areas outside of work areas, the action area for aquatic species and habitat is the mainstem Willamette River in the vicinity of the Terminal 4 Removal Action Area, including 0.3 miles (RM 5.0) upstream of Terminal 4 and downstream to the Multnomah Channel (RM 3.5). The action area for terrestrial wildlife species is the area encompassing a 0.5-mile radius from the Removal Action Area.

The biological requirements of salmonids have been defined above in Section 5.0 and indicators of habitat quality were defined in terms of the concept of PFC. PFC is the sustained presence of natural habitat-forming processes in a watershed that are necessary for long-term survival of the species. All habitat indicators (with the exception of substrate quality, which does not include contamination) in the Lower Willamette River are either at risk or not properly functioning. NOAA Fisheries (1996) has developed an analytic methodology using the concept of PFC to help determine the environmental effects of a given action by describing an action's effects on PFC. This includes use of the MPI (NOAA Fisheries, 1996), which represents six conceptual groups (e.g. water quality, habitat access, habitat elements, etc.) and 18 habitat indicators (temperature, sediment, chemical contamination, etc.).

Effects of the proposed action on aquatic habitat are displayed in a project-specific MPI (Table P-10), and are classified as to whether the action will restore, maintain or degrade a particular indicator. As shown in the project-specific MPI, effects of the proposed action are limited to two indicators: sediment and chemical contamination. In addition, the proposed action may impact the amount or extent of shallow water habitat. Shallow water habitat is not included in the MPI, but is included in the following analysis because juvenile salmonids may prefer shallow habitat in the action area. The remaining indicators in the MPI will not be affected by the proposed action; i.e. existing conditions for the remaining indicators will be "maintained." Thus, the following analysis for aquatic species and habitat is not organized by MPI indicators, but rather by proposed technologies and associated potential effects.

The Preferred Alternative includes the technologies of removal (dredging), containment (capping), MNR and a CDF. Dredging and disposal in a CDF are the main technologies proposed, addressing 57% of the Removal Action Area. Capping would address about 19% of the Removal Action Area and, with time, MNR would address about 44% of the Removal Action Area.

P-5.1 Dredging

Slip 3, specifically the area between Pier 4 and 5, will be dredged. Dredging will also be performed in front of Pier 4 to remove contamination. Slip 3 is an active slip where dredging has already occurred a number of times for berth deepening and maintenance purposes. The area under the containment berm in Slip 1 will be dredged prior to establishment of the berm. Some dredging (but primarily capping), will be used at a relatively small slope area at the head of Slip 3 below the existing pinch pile bulkhead. Shallow water habitat will not be dredged.

Technologies that will be used for dredging, handling sediments, transportation of sediments and CDF placement of dredged sediment are those that are considered technically feasible and are proven technologies that have been implemented at several contaminated sediment remediation projects in the Pacific Northwest (BBL, 2005).). The initial design proposes to use either mechanical dredging (clamshell bucket) or hydraulic dredging. If mechanical dredging is used, the material will be placed on a split-hull/bottom-dump barge and then taken to the CDF for disposal. If hydraulic dredging is used, the material will be pumped via pipes directly to the CDF in Slip 1 and likely result in low resuspension of sediment.

P-5.1.1 Direct Effects of Dredging

The potential direct effects of dredging can include entrainment of juvenile salmonids, short-term and localized impacts related to increased turbidity and resuspension of contaminated sediments. The potential for actual effects to salmonids is low due to use of in water work windows that avoid peak migrations of salmonids and due to the type of habitat that is available in the work areas. The in-water work would occur during a time period designated by ODFW as a preferred work window (July 1 through October 31 and/or a preferred winter in water work window), which would minimize contact and interference effects to migrating salmonids. Adult salmonid are not expected to be in the action area during implementation of the proposed action, thus effects to adult salmonids are expected to be negligible. Juveniles may rest and feed in shallow water habitats in the lower Willamette River. Although use of the work areas by juvenile salmonids is expected to be low due to project timing and due to existing conditions in the work areas, juvenile salmonids could be present in low numbers during project implementation.

P-5.1.1.1 Turbidity

Turbidity will be increased in the short-term and in a localized area where dredging occurs and during construction of the CDF. If salmonids are exposed to moderate to high levels of turbidity for prolonged periods, a number of adverse effects could occur including behavioral changes, sub-lethal effects and increased mortality from predators. Moderate levels of increased turbidity over prolonged periods of time can also decrease primary and secondary productivity. Dredging and associated activity will be of limited duration. Because operations will occur at low flows, and the work areas are in areas of low velocity, turbidity will likely be limited to work areas and the immediate vicinity. If turbidity increases beyond established criteria (refer to conservation measures), work would cease until conditions return to acceptable levels above background.

Use of a hydraulic dredge would significantly reduce resuspension of sediments and turbidity. Use of a clamshell dredge would also minimize turbidity compared to other technologies but not to the extent of a hydraulic dredge. Disturbance associated with dredging is expected to scare fish out of work areas, which will minimize injury to salmonids that could result from moderate to high turbidity in the work area. Changes in turbidity are expected to be short-term and localized due to the fact that operations will cease if criteria are exceeded. The in-water work will be conducted during periods designated by ODFW as a preferred in-water work windows that avoid important salmonid migration periods. Thus, appropriate timing of work would also help minimize exposure of salmonids to turbidity.

P-5.1.1.2 Chemical Contaminants

Dredging would reduce the volume of contaminants currently present in the Removal Action Area. Sediments would be disposed of onsite in a CDF, which would reduce the potential for contamination offsite (if materials were transported and disposed of elsewhere). The mobility of contaminants in the dredged material would be reduced at disposal because the CDF berm would be designed to limit the mobility of COPCs in liquid phase, thus reducing the risk to aquatic species. The CDF would also be capped, thus reducing the availability and mobility of chemicals affecting terrestrial species. The chemical natures of contaminants are unlikely to change with dredging and disposal in a CDF.

Despite implementation of minimization measures, disturbance of sediments may expose salmonids, if they are in the project vicinity, to contaminants in the short-term as sediments are resuspended and concentrations of contaminants increase in the water column. Direct exposure could include contact with contaminated sediments or ingestion of sediments. Indirect exposure includes ingestion of food or water that may be contaminated. As described in the environmental baseline section of this document, in 1997, the DEQ and USEPA undertook sampling of sediments within the Lower Willamette River. Results of the study indicated that sediments in discrete areas of a segment between River Mile 3.5 and River Mile 9.2 contained concentrations of metals, PCBs, pesticides, herbicides, dioxins/furans, TBT, and PAHs above USEPA contaminant guidelines. PCBs can adversely affect salmonids as exposure can cause mortality, impaired growth and reproduction, immune dysfunction, hormonal alterations, enzyme induction, neurotoxicity, behavioral responses, disease susceptibility and mutagenicity (Meador, 2000). Juvenile salmonids are more vulnerable to contaminant effects than adults due to the lesser quantity of muscle and lipid tissues. To minimize effects outside of the work areas, dredging will be accomplished using the most appropriate technologies that minimize sediment resuspension.

Spills and accidental releases of dredged material during handling and filling into the CDF will be minimized and mitigated by devising and implementing appropriate material handling and containment procedures. Using the onsite CDF at Slip 1 to dispose of dredged materials from Slip 3 reduces the potential for offsite spills and contamination.

Dredging will disturb or kill benthic invertebrates within areas to be dredged. However, it is expected that existing contamination of bottom sediments in some areas has likely reduced the suitability of habitat for benthic invertebrates. Post-project, contamination of bottom sediments will be reduced. Species such as midge larvae and amphipods could rapidly recolonize disturbed areas. Dredging would result in a short-term reduction in numbers of benthic invertebrates, but recolonization will occur quickly after dredging. Thus, the proposed action may increase the quality of food sources for salmonids. Locations at which sediments were shown to be toxic by laboratory testing (Hart Crowser, 2000) are being dredged to non-toxic concentrations. This would represent a significant reduction in risk to benthic invertebrates and fish relative to baseline conditions. Dredging would reduce exposure at project completion and over the long-term by reducing the quantity and concentration of contaminated sediments.

P-5.1.1.3 Equipment Impacts

Use of equipment over and in the water has the potential to kill or injure aquatic organisms if fuels and other petroleum products enter the water. To ensure that spills will be prevented, the applicant has formulated a pollution prevention and control plan that will be implemented. Due to the minimization measures proposed, the potential for injury to salmonids from a fuel spill is negligible.

P-5.1.1.4 Physical Habitat Changes

Bathymetric changes will occur at Slip 3 as a result of dredging, as the Slip bed surface is lowered in localized areas. Areas to be dredged at Slip 3 are deep-water habitats that could be used by fish migrating past the subareas, but are not the primary migration corridor. Dredging deep water habitat at Slip 3 would not change the suitability of the action area for migration and would not decrease its value relative to providing velocity refuge for migrating salmonids. Relative to the action area, shallow water habitat would be most suitable for juvenile rearing and feeding. Dredging in Slip 3 will not occur in shallow water habitat. Dredging will occur in Slip 1 on the footprint of the containment berm, however, the entire area will be filled for the CDF. Loss of habitat associated with the CDF will be evaluated and mitigated, as appropriate, in accordance with applicable federal and state ARARs. Terminal 4 is an active marine terminal that has had maintenance dredging conducted periodically as needed; dredging began as early as 1917 and 1921 and maintenance dredging of the slips and improvements to the terminal's harbor face occurred in ensuing years. The areas to be dredged have been previously dredged for commercial boat access, thus there have been repeated disturbances to existing habitat in the work areas, which have already changed historic habitat quality and quantity.

In both slips and other subareas, shallow water habitat is restricted to narrow bands around the perimeter of each slip, under docks and along the shoreline, and these areas would not be dredged. Larger areas of shallow water are located in Wheeler Bay (this area will not be dredged) and in a small area immediately northeast of Berth 401 (this area will not be dredged).

P-5.1.1.5 Indirect, Interrelated and Interdependent Effects of Dredging

No indirect, interrelated or interdependent effects of dredging were identified that would affect any listed or proposed species.

P-5.2 Capping

A relatively small area in the northeast corner of the Berth 401 subarea will be capped because of marginal PCB and phthalate concentrations found in one sample location. In Wheeler Bay, capping will be used along a portion of the steeper slopes, and scour protection for the cap will be placed in areas with frequent vessel traffic. Capping is proposed for the area along the shoreline, because marginally high PAH concentrations and a PEC exceedance for zinc were encountered, and the area cannot be effectively dredged. Some dredging, but primarily capping, will be used at a relatively small slope area at the head of Slip 3 below the existing pinch pile bulkhead.

P-5.2.1 Direct Effects of Capping

Direct effects of capping include short-term increases in turbidity associated with placement of the cap material, short-term resuspension of sediments when cap materials are placed, burying aquatic invertebrates with cap materials and beneficial effects to substrate quality and food source quality.

P-5.2.1.1 Turbidity

Turbidity would be increased during placement of a cap over bottom substrates. The potential effects of increased turbidity are described above under dredging. However, increases in turbidity are expected to be minimal during cap placement due to limitations on fine sediment composition in the cap material. Water quality impacts caused by resuspension of sediment during capping would be minimized by implementation of a water quality monitoring plan.

P-5.2.1.2 Chemical Contaminants

Capping would not change the volume or toxicity of contaminants, however, the mobility of contaminants would be reduced. Relative to existing conditions, effects to aquatic species within the Removal Action Area would be reduced as capping would effectively isolate the contaminants from aquatic species. As a result of capping, risks to benthic invertebrates and fish would be substantially reduced relative to baseline conditions.
Capping would also reduce impacts to habitat outside of the Removal Action Area (i.e. areas downstream) by preventing contaminants from being transported into other areas of the Willamette River. The caps would be designed and constructed to effectively limit chemical flux from the sediment to the water and ecological receptors (BBL, 2005).

Capping will create a barrier between contaminated sediment and potential receptors, thus preventing direct exposure to sediments, and indirect exposure through bioaccumulation of contaminants. Thus, capping is a control measure for the benthic contaminant pathway. Since the Removal Action Area is an active navigational channel and has been modified for this use, use by salmonids may be limited. However, juveniles emigrating through the area may rest and feed, especially in shallow water areas. Researchers (Collier et al., 1998; Stein et al., 1995) found that food intake by juvenile salmonids is a primary route of contaminant exposure. Thus, benthic invertebrates currently inhabiting the Removal Action Area could potentially be an ongoing source of contaminants to juvenile salmonids as they migrate through and feed in the area. Capping would be a significant benefit to juvenile salmonids, relative to existing conditions, as the substrate quality and quality of food sources would be improved post-project.

Benthic invertebrates located in areas to be capped would be buried, thus, there would be a short-term reduction in food sources for salmonids. However, it is expected that existing contamination of bottom sediments has reduced the suitability of habitat for benthic invertebrates and other aquatic biota. Post-project, contamination of bottom sediments will be reduced. Species such as midge larvae and amphipods could rapidly recolonize disturbed areas. Dredging would result in a short-term reduction of benthic invertebrates, but recolonization would occur rapidly the quality of food sources for salmonids would improve.

P-5.2.1.3 Equipment Impacts

Use of equipment over and in the water has the potential to kill or injure aquatic organisms if fuels and other petroleum products enter the water. To ensure that spills will be prevented, the applicant has formulated a pollution prevention and control plan that will be implemented. Due to the minimization measures proposed, the potential for injury to salmonids from a fuel spill is negligible.

P-5.2.1.4 Physical Habitat Changes

Capping will occur over 3.5 acres of shallow water habitat. This would reduce the depth of existing shallow water habitat, which may increase productivity of treated areas. Placement of caps on steeper slopes will be designed for stability by selecting cap materials with sufficient strength to be stable on steep slopes and by devising methods to place the cap to maintain its stability, such as scheduling placement starting at the toe of the slope and building it in an upward direction (BBL, 2005). Capping is not expected to result in a loss of shallow water habitat, and would improve the substrate quality in areas treated.

P-5.2.1.5 Indirect, Interrelated and Interdependent Effects of Capping

No indirect, interrelated or interdependent effects of capping were identified that would affect any listed or proposed species.

P-5.3 Monitored Natural Recovery

MNR is proposed for parts of all three subareas, primarily in the riverward sections of the Removal Action Area where COPC concentrations were generally the lowest. Monitoring sediments will be conducted for five years after removal action construction. If sediments in the MNR areas do not achieve RAOs, as indicated by consistency with risk criteria or sediment cleanup goals developed for the Portland Harbor Superfund Site, the area will be evaluated for active removal or remedial actions.

P-5.3.1 Direct Effects of Monitored Natural Recovery

Direct effects are not expected from implementation of MNR. Continued monitoring is not expected to cause adverse impacts to aquatic species or their habitats.

P-5.3.2 Indirect, Interrelated and Interdependent Effects of MNR

MNR is not expected to have interrelated or interdependent effects.

P-5.3.2.1 Turbidity

MNR would not result in increased turbidity.

P-5.3.2.2 Chemical Contaminants

Relative to existing conditions, adverse effects of MNR are expected to be minimal. Areas to be addressed through MNR have much lower levels of COPCs in sediments, and contribute minimally to risk of adverse effects on human health and the environment.

Concentrations in areas proposed for MNR exceeded some TECs, but concentrations are not expected to have long-term adverse effects on the benthic community. Direct effects on fish and wildlife are also not expected. Monitoring data from the site will be compared to risk criteria developed for the Portland Harbor Superfund Site to make this determination.

MNR areas would be periodically monitored either through analysis of chemical concentrations in sediments, assessment of biological community structure and function or combinations of both strategies. MNR would not result in any short-term impacts to invertebrates, but would identify potential areas of concern, through monitoring, over the next five years.

P-5.3.2.3 Equipment Impacts

Equipment associated with MNR would not impact aquatic species or their habitat.

P-5.3.2.4 Physical Habitat Changes

MNR would not result in changes to physical habitat.

P-5.4 Confined Disposal Facility

The Removal Action consists of construction of an at-grade CDF that will occupy the entire Slip 1. Sediment dredged from Slip 3 and other areas will be disposed of in the Slip 1 CDF. CDFs include the placement of dredged materials within diked and submerged nearshore areas.

A containment berm will be constructed at the mouth of Slip 1 to isolate and retain the dredged sediment. The area under the containment berm will be dredged prior to establishment of the berm (the effects of dredging are described above). The containment berm will be comprised of 138,500 cy of material with a CDF cap placement of about 255,000 cy of material (upon completion of the filling of the excess capacity in the CDF, the final cap would be placed). About 115,000 cy of sediments from dredging Terminal 4, mainly from Slip 3, would be placed into the CDF as part of the Preferred Alternative. An excess capacity for up to 560,000 cy would be available to accept other materials.

P-5.4.1 Direct Effects of a Confined Disposal Facility

P-5.4.1.1 Work Area Isolation

The CDF work area may be isolated through use of a silt curtain or other means. As the CDF design is refined greater detail may be provided. The berm surrounding the CDF would be constructed first, to isolate the CDF area so that dredged material may be placed with minimal impact to the surrounding aquatic environment. The containment berm would isolate turbidity and resuspended sediments and would minimize the potential for impacts to salmonids. If the final construction plan specifies that hydraulic dredging will be used to fill the CDF, then the CDF will be isolated from the river by the berm. If the construction plan allows for transport of dredged materials by barge, a portion of the berm will remain open to the river to allow for barge passage. If barge passage is required, best management practices such as installation of silt curtains would isolate work areas/turbid waters will be implemented to minimize impacts on salmonids outside the CDF. The project water quality monitoring plan will include monitoring turbidity outside the berm. The plan will also provide for corrective actions to be taken if water quality outside the berm is unacceptably affected by turbidity or other factors from the work areas. Since the work area is not the main migration corridor, and the area is limited in extent relative to the amount of open water surrounding the CDF and in the Willamette River, fish would be able to avoid work areas and migrate past. Disturbance associated with in-water construction activities would deter fish from entering work areas or resting nearby. However, there is more than a negligible risk of direct effects to salmonids because they do have access to the work area and could be trapped or buried during construction or closure of the berm and placement of dredged materials. Prior to closure of the CDF berm, any listed fish would be relocated out of the CDF area. The effects of relocation would be minimized through use of proper sampling and handling techniques.

P-5.4.1.2 Turbidity

Increased turbidity would occur in the CDF footprint during the submerged placement of the containment berm. Discharge of hydraulic dredge effluent into the CDF will increase turbidity within the containment area. Dredge production rates and proper effluent routing will be used to shorten settling times and decrease the potential for turbidity releases to ambient waters. Effects to habitat outside of the work area are expected to be minimized by use of silt curtains or other BMPs to control off-site transport of increased turbidity.

P-5.4.1.3 Chemical Contaminants

The CDF would be filled with sediment delivered in slurry form, which will displace water from the CDF. Containment techniques, including controlled placement of the sediment and use of silt or turbidity curtains, would be used to meet water quality criteria established for the CDF construction period.

P-5.4.1.4 Equipment Impacts

Use of equipment over and in the water has the potential to kill or injure aquatic organisms if fuels and other petroleum products enter the water. To ensure that spills will be prevented, the applicant has formulated a pollution prevention and control plan that will be implemented. Due to the minimization measures proposed, the potential for injury to salmonids from a fuel spill is low.

P-5.4.1.5 Physical Habitat Changes

The at-grade CDF in Slip 1 would result in a permanent filling and reduction of 15.3 acres of aquatic habitat, of which about 3.1 acres is shallow water. Other areas to be filled may provide velocity refuge for salmonids during higher flow events. Quality habitat (e.g. quality holding and rearing habitat) has been degraded or lost in the Lower Willamette River in general, and habitat in Slip 1 has been modified and degraded by industrial development and use. However, habitat functions and values lost as a result of the CDF will be evaluated and mitigated, as appropriate, in accordance with applicable federal and state ARARs.

P-5.4.1.6 Indirect, Interrelated and Interdependent Effects of Capping

It is anticipated that the capacity of the CDF for contaminated dredged material will exceed the volume to be dredged from the Removal Action Area. This excess capacity may be filled with materials accepted from other dredging projects in the lower Willamette River, or other nearby areas. The potential sources of dredged material are not known. However, placement of such materials in the CDF would be subject to evaluation and controls pursuant to a USEPA approved operation and maintenance plan. Once the CDF is at-grade, the newly created land may be used for a purpose similar to uses in the surrounding area. Potential future uses are not known, however, any future use would be subject to the Port’s storm water management program and other requirements consistent with the Port’s and agency requirements.

P-5.5 Effects Analysis for Wildlife Species

P-5.5.1 Bald Eagle

The potential direct effects of the proposed action to bald eagles include noise disturbance from construction activities and resuspension of contaminants into the water column that could be transported off Site. These potential effects are expected to be localized and temporary. It is likely that the eagles will avoid the immediate area. In addition, local bald eagle populations are likely accustomed to various activities, as this is a heavily industrialized area. Noise from the Removal Actions may not be measurable given existing background noise and activity. Degradation of eagle habitat is not expected. Survival and reproductive success of eagles would not be affected. Waters would be turbid during dredging making foraging unlikely and containment of contaminated sediments during dredging will reduce the potential for exposure.

The closest nest is approximately 1.9 miles away. Guidelines from USFWS recommend a 100 meter diameter primary zone around eagle nests in which disruptive activity or alteration of vegetation is restricted year round, and a 200 meter diameter secondary zone in which disruptive activity is restricted from March to August. Implementation of the Preferred Alternative will occur far outside of these zones; therefore, nesting will not be adversely affected.

Effects minimization actions listed previously will serve to minimize potential effects on bald eagles. No additional actions are warranted.

The proposed action would not result in any long-term degradation of habitat or other adverse effects on bald eagles. Short-term effects such as noise disturbance or exposure to contaminated sediments will not occur or would be undetectable. The survival or reproductive success of eagles in the project vicinity would not be affected.

P-5.5.2 Streaked horned lark and Yellow-billed cuckoo

Streaked horned lark and yellow-billed cuckoo are grassland and cottonwood-willow dependent species, respectively. Neither of these habitats exists in the Terminal 4 Removal Action Area because it is an active marine terminal with heavy industrial use surrounding the slips and berth areas. Riverbanks are either heavily armored or covered with operating or dysfunctional pier structures. Some natural substrate is present in Wheeler Bay; however, no riparian trees such as willow or cottonwoods are present. Review of the available information for these species and their potential presence within the vicinity of the project area suggests that yellow-billed cuckoo in the Portland Metro area are extirpated and streaked horned lark are virtually extirpated in the Portland Metro area. Loss of both of these species is due to loss of habitat.

Because habitats for these species are not present as part of the Terminal 4 Removal Action Area and the species are largely expected to not be present in the Portland Metro Area, implementation of the Preferred Alternative is not expected to adversely affect either of these species. Effects minimization actions listed previously will serve to minimize potential effects on these species. No additional actions are warranted.

P-6. *Cumulative Effects*

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area. The action area for this project includes a portion of the lower Willamette River. This area has been historically disturbed for industrial, commercial and urban uses and disturbance has included loss of riparian function, changes in channel morphology due to dredging, diking and backfilling and impacts to water quality from industrial and urban discharge over the past 100 years. These activities have influenced the hydrology and morphology of channels, limited the extent of riparian vegetation, redirected hydraulic forces and generally changed the quality of instream habitat. These factors combined contribute cumulatively to degradation of aquatic habitat. This project, as well as ongoing and past similar clean-up projects contribute cumulatively to short term degradation of habitat quality, but will cumulatively reduce impacts and are restorative in the context of a degraded environmental baseline. Future projects that require Federal permitting or funding are not analyzed here, as they would be subject to section 7 consultation in the future.

There would be no significant cumulative, interrelated or interdependent effects on terrestrial wildlife species from the proposed project even when considered in conjunction with other projects or actions in the action area.

P-7. *Conservation Measures*

The following information summarizes measures likely to be implemented and that would minimize adverse effects of the proposed action on listed species or their habitat. These measures may be modified or added to upon refinement of the Preferred Alternative:

1. Minimize turbidity and contaminant release outside of the proposed work areas through use of a silt curtain, or other means, as appropriate.
2. Minimize adverse effects to aquatic species and habitat through water quality monitoring.
3. Minimize adverse effects to aquatic habitat and species associated with chemical contamination and sediment resuspension through use of appropriate dredging and transport technologies.
4. Minimize contamination and turbidity outside of work areas during transport of dredged sediments through use of appropriate technologies.
5. Minimize chemical contamination of aquatic habitat associated with heavy equipment through proper cleaning and prevention of spills.
6. Minimize adverse effects to aquatic species and habitat associated with contamination by minimizing transport and handling of contaminated materials and by disposing dredged material in an onsite CDF.
7. Minimize the potential for adverse effects to salmonids by scheduling, to the degree possible, all in-water work within a work window recommended by ODFW, typically July 1 to October 31 and/or a secondary preferred work window of December 31 to January 31.
8. Minimize potential adverse effects of petroleum spills and other construction-related impacts by developing a spill containment and control plan and through identification of acceptable limits of work areas.
9. If site conditions allow for fish relocation, any listed salmonids trapped within the CDF would be captured by beach seining or another sampling method and relocated to the Willamette River. The effects of relocation would be minimized through use of proper sampling and handling techniques.
10. Floating hazardous material containment booms will be maintained on site where there is potential for release of petroleum or other toxic substances.
11. Compensatory mitigation will be implemented, as appropriate, in compliance with federal and state ARARs, to offset the habitat function and values lost through construction of the CDF.

P-8. *Determination*

Although the Removal Action is restorative in nature relative to existing conditions of sediment contamination, short-term adverse effects may occur associated with construction activities including increased turbidity, disturbance of contaminated sediments, and initiation of fright responses in salmonids as a result of equipment working. Due to industrial and commercial use of this area, it is unknown to what extent juvenile salmonids utilize habitat in Slip 1 that will be filled. However, the loss in terms of the relative function and value of this habitat will be evaluated and mitigated, as appropriate, in accordance with applicable federal and state ARARs.

After evaluating the potential effects and available scientific and commercial data, it is concluded that the proposed action would result in a "likely to adversely affect" determination for the following five federally listed Pacific salmonids/ESUs:

- Lower Columbia River Chinook Salmon (*Oncorhynchus tsshawytscha*);
- Upper Willamette River Chinook Salmon (*Oncorhynchus tshawytscha*);
- Columbia River Chum Salmon (*Oncorhynchus keta*);
- Lower Columbia River Steelhead (*Oncorhynchus mykiss*); and
- Upper Willamette River Steelhead (*Oncorhynchus mykiss*).

This determination is based on the potential for short-term effects associated with project implementation. In addition, work area isolation may require the relocation of salmonids from the work areas. The proposed action "will not jeopardize" the Lower Columbia River/Southwest Washington Coastal Coho Salmon ESU, which is currently listed as a candidate species.

Based on the limited use of the action area by bald eagles, historic disturbance regimes, and anticipated impacts, the proposed action would have "no effect" on bald eagles, streaked horn larks or yellow-billed cuckoo.

P-9. *Essential Fish Habitat*

The MSA requires evaluation of impacts on habitat of commercially managed fish populations. The action area contains EFH for West Coast Groundfish and Pacific Coast Salmon. Of the 83 species of West Coast groundfish, starry flounder (*Platichthys stellatus*) is the only species found within the action area. Starry flounder have been captured in shallow water habitat areas in the lower Willamette River, near St. Johns Bridge (Ellis Ecological Services, 2003). The action area also contains EFH for Chinook and coho salmon.

Direct Effects

Direct effects to starry flounder EFH include dredging of substrates as described in previous sections of this BA. As described above, water quality impacts would be short-term, localized and limited to isolated work areas and impacts would be minimized through implementation of conservation measures. Post-project, water quality and substrate quality would be improved relative to existing conditions.

Effects to Chinook and coho salmon EFH have been described above in Section 5.0. Short-term and localized effects include increased turbidity and resuspension of sediments. Water quality and substrate quality are expected to improve post-project. The loss of habitat associated with the CDF, in terms of the relative function and value of the habitat, will be evaluated and mitigated, as appropriate, in accordance with applicable federal and state ARARs.

Indirect Effects

Indirect effects, as defined for EFH, include disturbance of benthic food organisms. Dredged areas will experience a short-term reduction in benthic food organisms, however, post-project the quality of sediments and benthic food organisms will be improved. In the short-term, dredging may result in temporary, indirect adverse affects on starry flounder EFH and Pacific salmon EFH.

Creation of the CDF will result in permanent (short- and long-term) loss of benthic food production in Slip 1, however, this loss will be mitigated in accordance with applicable federal and state ARARs. Based on the short-term reduction in benthic food organisms and effects associated with the CDF, it is concluded that the effects of the proposed action “may adversely affect” Pacific Coast Salmon EFH and West Coast Groundfish EFH. Long-term effects to EFH in the action area are expected to be beneficial based on the reduction of sediment contamination.

P-10. *References*

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Table P-1
Federal Threatened, Endangered, Proposed, and Candidate Species Terrestrial Species

Common Name	Scientific Name	Federal Status	Listing Reference
Listed Species			
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	T	FR, Vol. 60, No. 133, July 12, 1995 - Final Rule Bald Eagle
Plants			
Golden Paintbrush	*Castilleja levisecta*	T	FR, Vol. 62, No. 112, June 11, 1997 - Final Rule *Castilleja levisecta*
Kincaid's Lupine	*Lupinus sulphureus ssp. Kincaidii*	T	FR, Vol. 65, No. 16, January 25, 2000 - Final Rule *Erigeron decumbens var. decumbens, Lupinus sulphureus ssp. kincaidii* and Fender's blue butterfly
Willamette Daisy	*Erigeron decumbens*	E	FR, Vol. 65, No. 16, January 25, 2000 - Final Rule *Erigeron decumbens var. decumbens, Lupinus sulphureus ssp. kincaidii* and Fender's blue butterfly
Howellia	*Howellia aquatilis*	T	
Bradshaw's Lomatium	*Lomatium bradshawii*	E	
Nelson's Checker Mallow	*Sidalcea nelsoniana*	T	
Candidate Species			
Birds			
Yellow-billed Cuckoo	*Coccyzus americanus*	C	FR, Vol. 66, No. 143, July 25, 2001 - 12-Month Finding for a Petition To List the Yellow-Billed Cuckoo
Streaked Horned Lark	*Eremophila alpestris strigata*	C	

T = Threatened
E = Endangered
C = Candidate

Table P-2
Pacific Salmonids Listed Under the ESA That May Use Habitat Within the Action Area

Species ESU	Listing Status	Critical Habitat
Chinook Salmon (*Oncorhynchus tshawytscha*)		
Lower Columbia River	Threatened 3/24/99; 64 FR 14308	Not Applicable
Upper Willamette River	Threatened 3/24/99; 64 FR 14308	Not Applicable
Chum Salmon (*O. keta*)		
Columbia River	Threatened 3/25/99; 64 FR 14508	Not Applicable
Steelhead (*O. mykiss*)		
Lower Columbia River	Threatened 3/19/98; 63 FR 13347	Not Applicable
Upper Willamette River	Threatened 3/25/99; 64 FR 14517	Not Applicable

Sources:
Chum: FR, Vol. 64, No.57, March 25, 1999 - Final Rule Columbia River Chum Salmon.

Steelhead: FR, Vol. 64, No. 57, March 25, 1999 - Final Rule Middle Columbia and Upper Willamette River Steelhead and FR, Vol. 63, No. 53, March 19, 1998 - Final Rule West Coast Steelhead.

Chinook: FR, Vol. 64, No. 56, March 24, 1999 - Final Rule West Coast Chinook Salmon.

Table P-3
Technologies and Quantities for Each Removal Action Sub Areas

Alternative	Emphasis	Technology and Area (CY)	Slip 1	Slip 3	Wheeler Bay	North of Berth 414	Berth 401	Totals
C	Dredge w/ at grade full CDF	Dredging Acres (CY)	1.0 (10,000)	9.2 (105,000)		NA	NA	10.2 (115,000)
		Capping Acres (CY)		4.5 (22,000)	3.0 (14,500)	NA	1.2 (5,500)	8.7 (42,000)
		Monitored Natural Recovery Acres	0.9	0.7	4	3	2.3	10.9
		Confined Disposal Facility Acres	15.3	NA	NA	NA	NA	15.3

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Table P-4
Fish Species Collected in the Lower Willamette River
(EES, 1998, EES, 2000, EES, 2003)

Fish Species		
Family, Species	**Common Name**	**Willamette River**
Petromyzontidae	Lampreys	X
Aciperseridae	Sturgeons	X
Acipenser transmontanus	White Sturgeon[a3]	X
Clupeidae	Herrings	X
Alosa sapidissima	American Shad[a2]	X
Salmonidae	Trouts and Salmon	X
Oncorhynchus kisutch	Coho Salmon[b3]	X
Oncorhynchus tshawytscha	Chinook Salmon[b3]	X
Oncorhynchus keta	Chum Salmon[b3]	
Oncorhynchus nerka	Sockeye Salmon[b3]	
Oncorhynchus clarki clarki	Coastal Cutthroat Trout[b3]	
Oncorhynchus mykiss	Steelhead Trout[b3]	X
Cyprinidae	Carps and Minnows	X
Ptychocheilus oregonensis	Northern Pikeminnow[c1]	X
Mylocheilus caurinus	Peamouth[b2]	X
Acrochilus alutaceus	Chiselmouth[e2]	X
Richardsonius balteatus	Redside Shiner[b1]	
Cyprinus carpio	Common Carp[a1]	X
Carassius auratus	Goldfish[a1]	X
Catastomidae	Suckers	X
Catostomus macrocheilus	Largescale Sucker[a1]	X
Ictaluridae	Catfishes	X
Ameiurus natalis	Yellow Bullhead[a1]	X
Ameiurus nebulosis	Brown Bullhead[a1]	X
Ictalurus punctatus	Channel Catfish[a1]	X
Cyprinodontidae	Killifishes	X
Fundulus diaphanous	Banded Killifish[b2]	X
Gasterosteidae	Sticklebacks	X
Gasterosteus aculeatus	Threespine Stickleback[b2]	X
Centrarchidae	Sunfishes	X
Pomoxis annularis	White Crappie[b1]	X
Pomoxis nigromaculatus	Black Crappie[b1]	X
Micropterus dolomieui	Smallmouth Bass[c2]	X
Micropterus salmoides	Largemouth Bass[c1]	X
Lepomis macrochirus	Bluegill[b1]	X
Lepomis gibbosus	Pumpkinseed[b1]	X
Lepomis gulosus	Warmouth Bass[c1]	X
Percidae	Perches	X

Fish Species		
Family, Species	Common Name	Willamette River
Perca flavescens	Yellow Perch[b2]	X
Morone saxatilis	Striped Bass [c2]	X
Stizostedion vitreum	Walleye [c2]	X
Cottidae	Sculpins	X
Leptocottus armatus	Pacific Staghorn Sculpin[b1]	
Cottus asper	Prickly Sculpin [b1]	X
Pleuronectidae	Flounders	X
Platichthys stellatus	Starry Flounder[c1]	X

Trophic Group: a= omnivore; b=insectivore; c=piscivore; d=parasitic; e=herbivore
Pollution Tolerance: 1= tolerant; 2= intermediate; 3= intolerant
Source: (EES, 1998, EES, 2000, EES, 2003)

Table P-5
Summary of Species of Concern in Oregon

Common Name	Scientific Name
Mammals	
Pacific Western Big Eared Bat	*Corynorhinus (=plecotus) townsendii townsendii*
Silver-haired Bat	*Lasionycteris noctivagans*
Long-eared Myotis	*Myotis exotis*
Fringed-Myotis	*Myotis thysanodes*
Long-legged Myotis	*Myotis volans*
Yuma Myotis	*Myotis yumanensis*
Camas Pocket Gopher	*Thomomys bulbivorus*
Birds	
Tricolored Blackbird	*Agelaius tricolor*
Olive-sided Flycatcher	*Contopus cooperi (=borealis)*
Yellow-breasted Chat	*Icteria virens*
Oregon Vesper Sparrow	*Pooecetes gramineus affinis*
Purple Martin	*Progne subis*
Reptiles/Amphibians	
Northwestern Pond Turtle	*Clemmys marmorata marmorata*
Northern Red-legged Frog	*Rana aurora aurora*
Fish	
Pacific Lamprey	*Lampetra tridentata*
Green Sturgeon	*Acipenser medirostris*
Coastal Cutthroat Trout (Upper Willamette)	*Oncorhynchus clarki clarki*
Invertebrates	
California Floater	*Anodonta californiensis*
Columbia Pebblesnail (spire snail)	*Fluminicola fuscus (Fluminicola columbiana)*
Aquatic Plants	
White-topped Aster	*Aster curtus*
Peacock Larkspur	*Delphinium pavonaceum*
Pale Larkspur	*Delphinium leucophaem*

Table P-6
Mean Habitat Parameter Values of a Subset of Sampling Sites in the Lower Willamette River, October-November 2000

Site	Velocity (cm/s)	Depth (m)	Overhead Cover (%)	Temp (C)	Conductivity (µS)	Dissolved Oxygen (ppm)	Transparency (cm)	Shoreline Substrate (% natural)	Veg. Score	Bank Slope (degrees)	Pilings (#)	Outfalls (#)	Buffer Width (m)	Artificial Light (Lux)
006E	4.7	4.1	0.0	6.7	0.11	11.2	105	100	0.0	5	5	0	206	2.9
010E	6.7	4.4	12.4	6.5	0.10	10.9	150	100	2.5	7	536	3	33	6.4
012W	6.3	4.4	0.0	6.5	0.10	10.9	110	0	3.8	10	4	0	250	3.0
031W	16.4	1.4	0.0	6.6	0.09	11.2	131	100	1.0	5	13	0	250	3.4
048E	2.8	16.3	0.0	6.6	0.09	11.2	151	0	0.0	90	156	119	0	8.0
051E	6.2	6.4	19.8	6.6	0.09	11.1	165	0	3.3	23	86	13	19	7.5

Source:
ODFG, 2003. Relationships Between Bank Treatment / Nearshore Development and Anadromous/ Resident Fish in the Lower Willamette River, Annual Progress Report, July 2001-June 2002.
ODFG, 2002. Relationships Between Bank Treatment / Nearshore Development and Anadromous/ Resident Fish in the Lower Willamette River, Annual Progress Report, May 2000-June 2001.
Notes:
006E - Kelley Point at river kilometer 1-1.3, east bank, downstream of T4
010E - 3 T-docks above Columbia Slough at river kilometer 1.6 to 2.4, east bank, downstream of T4
012W - Between Coast Guard #6 and #10 at river kilometer 2-2.3, west bank, downstream of T4
031W - Head of Multnomah Channel at river kilometer 5-5.3, west bank, downstream of T4
048E - Terminal 4 at river kilometer 7.7-8, east bank, immediately upstream of T4
051E - Terminal 4 ship hull at river kilometer 8.2-8.7, east bank, upstream of T4

Table P-7
Oregon 303(d) Water Quality Status of the Lower Willamette River, From RM 0 to RM 24.8

Parameter	Standard/Criteria	Season	Supporting Data
Temperature	Water Column Criterion = 68°F (20.0°C)	Summer	DEQ Data collected each year between water years 1986 - 1995 (except 1991) show that 68% (34 of 50) of the samples recorded at RM 7.0 exceed the temperature standard.
PCB's	Fish Tissue	Year-round	Oregon Health Division fish advisory issued 11/21/01
Mercury	Fish Tissue	Year-round	Mercury concentrations have exceeded the criteria for fish tissue (0.35 pm) based on data collected since 1969. A public health advisory was issued for the consumption of fish tissue.
Biological Criteria	Water Column Fish Skeletal Deformities	Year-round	Incidence of skeletal deformities (22.7%) in juvenile northern pikeminnow collected at RM 25.5 were significantly higher than those measured in the upper river or reference site. RM 3 values were at background. Recent studies conducted by researchers at Oregon State University have shown that parasites may be causing fish skeletal deformities.
Bacteria (Fecal Coliform)	Water Column Geometric Mean of 200, No more than 10% of samples >400	Year-round	DEQ data show that 39% (20 of 51) of samples at RM 7.0 and 31% (20 of 65) of samples (fall, winter, spring) at RM 13.2 exceed fecal coliform standard, betwee water years 1986 - 1995.
Polynuclear Aromatic Hydrocarbons (PAH's)	Water Column Criterion = 2,800 pg/L	Year-round	USGS site at RM 6: 35 day average concentration of 52,900 pg/L.
Iron	Water Column Criterion = 300 ug/L	Year-round	DEQ data at RM 6.9 show that 2 of 4 samples exceed criterion.
Manganese	Water Column Criterion = 50 ug/L	Year-round	DEQ data at RM 13.1 show that 2 of 5 samples exceed criterion.
Pentachlorophenol	Sediment Criterion = 1.01 mg	Year-round	OSHD alert regarding fishing and swimming in the area of McCormick and Baxter due to soils and sediment contaminated by creosote.
Pesticides: (Dieldrin, Aldrin, DDE/DDT)	Fish Tissue	Year-round	Oregon Health Division fish advisory issued 11/20/01.
DDT	Water Column	Year-round	USGS data at RM 12.7 show that 2/9 samples exceeded the criterion of 0.000024 μg/L.

Source: Port of Portland and Ellis Ecological Services (2004)

Table P-8
Sediment Quality Guidelines and
Maximum Concentrations of Chemicals of Interest (COIs) in Sediments

Chemicals of Interest	TEC (Threshold Effects Conc.) or equivalent	PEC (Probable Effect Conc.) or equivalent	Maximum Sitewide Conc.[1]
Metals (mg/kg)			
Arsenic	9.79	33	
Cadmium	0.99	4.98	
Chromium	43.4	111	35
Copper	31.6	149	
Lead	35.8	128	
Mercury	0.18	1.06	
Nickel	22.7	48.6	
Selenium	NS	NS	3
Silver	1	2.2	
Zinc	121	459	
Semivolatile Organics (µg/kg)			
Naphthalene	176	561	
2-Methylnaphthalene	70	670	
1-Methylnaphthalene	130	NS	
Biphenyl	NS	1100	670
2,6-Dimethylnaphthalene	NS	NS	660
Acenaphthylene	5.9	130	
Acenaphthene	6.7	89	
2,3,5-Trimethylnaphthalene	NS	NS	260
Fluorene	77.4	536	
Phenanthrene	204	1,170	
Anthracene	57.2	845	
1-Methylphenanthrene	204	1,170	
Fluoranthene	423	2,230	
Pyrene	195	1,520	
Benz(a)anthracene	108	1,050	
Chrysene	166	1,290	
Benzo(b)fluoranthene	27.2	4,000	

Table P-8
Sediment Quality Guidelines and
Maximum Concentrations of Chemicals of Interest (COIs) in Sediments

Chemicals of Interest	TEC (Threshold Effects Conc.) or equivalent	PEC (Probable Effect Conc.) or equivalent	Maximum Sitewide Conc.[1]
Benzo(k)fluoranthene	27.2	4,000	53,000
Benzo(e)pyrene	NS	NS	36,000
Benzo(a)pyrene	150	1,450	
Perylene	NS	NS	14,000
Indeno(1,2,3-cd)pyrene	78	3,800	
Dibenz(a,h)anthracene	33	870	
Benzo(g,h,i)perylene	290	3,800	
Dimethyl phthalate	160	NS	19
Diethyl phthalate	630	NS	15
Di-n-butyl phthalate	NS	43	76
Butylbenzyl phthalate	NS	63	180
Bis(2-ethylhexyl) phthalate	180	2,600	
Di-n-octyl phthalate	NS	NS	29
Total PAHs (c,d)	1,610	22,800	
Pesticides (µg/kg)			
4,4'-DDE	1.42	6.75	
4,4'-DDD	3.54	8.51	
4,4'-DDT	1.19	4.77	
2,4'-DDE	9	15	3
2,4'-DDD	16	43	
2,4'-DDT	NS	NS	9
Total DDD (c,e)	4.88	28	
Total DDE (c,f)	3.16	31.3	
Total DDT (c,g)	4.16	62.9	
ΣDDTs (c,h)	5.28	572	
PCBs (µg/kg)			
Aroclor 1016	NS	NS	0
Aroclor 1221	NS	NS	0
Aroclor 1232	NS	NS	0

Table P-8
Sediment Quality Guidelines and
Maximum Concentrations of Chemicals of Interest (COIs) in Sediments

Chemicals of Interest	TEC (Threshold Effects Conc.) or equivalent	PEC (Probable Effect Conc.) or equivalent	Maximum Sitewide Conc.[1]
Aroclor 1242	NS	NS	120
Aroclor 1248	NS	NS	110
Aroclor 1254	NS	NS	140
Aroclor 1260	NS	NS	1,000
Aroclor 1262	NS	NS	0
Aroclor 1268	NS	NS	77
Total PCBs (c,i)	59.8	676	
Petroleum Hydrocarbons (mg/kg)			
Diesel Range Organics (DRO)	NS	NS	
Residual Range Organics (RRO)	NS	NS	
Gasoline Range Organics (GRO)	NS	NS	

[1] Maximum is for all depths. Shaded cells indicate maximum concentration exceeds TEC and COI is considered a COPC for benthos. Underlined cells indicate maximum concentration exceeds PEC.

Table P-9
Summary of Existing and Potentially Affected Conditions for Terminal 4 Select Habitat Parameters

Existing Conditions	Slip 1	Slip 3	Wheeler Bay	North of Berth 414	Berth 401	Total Habitat Type
<20 ft Water Depth (acres)	3.1	1.7	4.0	0.8	1.4	11
>20 ft Water Depth (acres)	11.5	11.7	1.2	1.4	1.2	27
<20 ft Water Depth, <20% Slope (acres)	0	0	3.2	0	0.6	3.8
Inundated Pilings (acres)	3.5	3.0	0.0	0.0	0.8	7.3
Overhead Pier Structures (acres)	1.6	1.8	0	0	0.5	3.9
Total Shoreline Length (ft)	3317	1875	1120	775	779	7866
Bank Type: structures length (ft)	2776	1523		696	432	5427
Bank Type: unclassified fill (ft)	425	352	766		347	1890
Bank Type: Seawall (ft)				79		79
Bank Type: Riprap (ft)	116		354			470

Bank Types as Classified by the City of Portland (2001).

Table P-10
Matrix of Pathways and Indicators for the Action Area

Pathways	Indicators	Environmental Baseline			Effects of the Action(s)					
		Properly Functioning	At Risk	Not Properly Functioning	Short Term			Long Term		
					Restore	Maintain	Degrade	Restore	Maintain	Degrade
Water Quality	Temperature			X		X			X	
	Sediment		X				X		X	
	Chemical Contam./Nutrients			X			X	X		
Habitat Access	Barriers		X			X		X		
Habitat Elements	Substrate	X			X			X		
	Large Woody Debris			X		X			X	
	Pool Frequency									
	Pool Quality									
	Off-Channel Habitat			X		X			X	
	Refugia			X		X			X	
Channel Cond./Dynamics	Width/Depth Ratio									
	Streambank Condition			X		X			X	
	Floodplain Connectivity			X		X			X	
Flow/Hydrology	Peak/Base Flows			X		X			X	
	Drainage Network Increase			X		X			X	
Watershed Conditions	Road Density and Location			X		X			X	
	Disturbance History			X			X	X		
	Riparian Reserves			X		X			X	

0 2 4

Scale in Miles

N

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TERMINAL 4 EARLY ACTION
EE/CA REPORT

VICINITY MAP

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FIGURE
P-1

0 600 1200

Approximate Scale in Feet

Note: Date of Photo: July 9, 2002

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TERMINAL 4 EARLY ACTION
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TERMINAL 4 AERIAL PHOTOGRAPH

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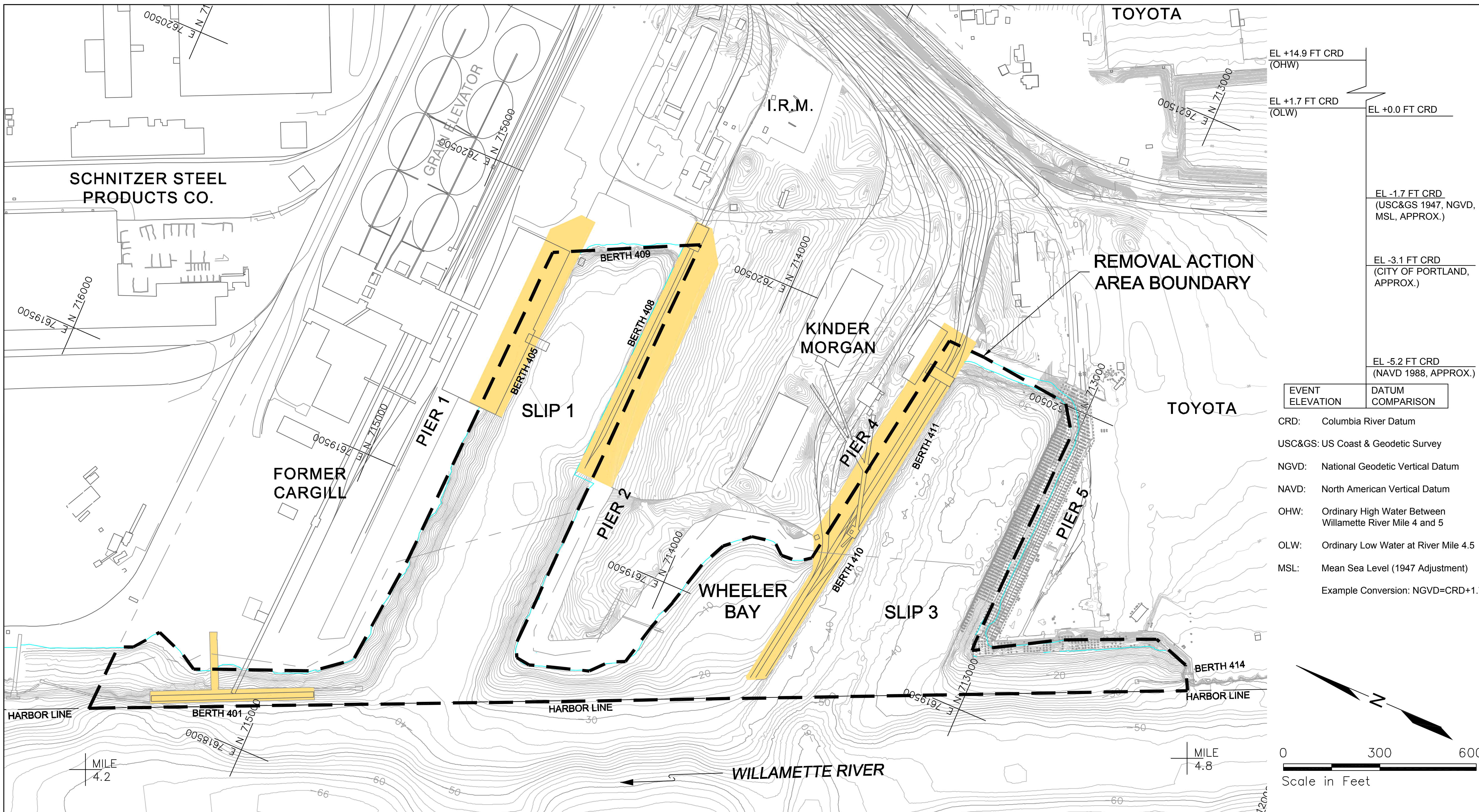
FIGURE
P-2



Notes:

1. Upland topographic vertical datum is NGVD; Bathymetric vertical datum is CRD.
2. Site Plan is based on drawings provided by the Port of Portland.
3. Shoreline boundary for Ordinary High Water is approximate.
4. Willamette River Mile reference marks are approximate.
5. Diurnal tide range during low river stages is 2.2 feet at St. Johns and 2.4 feet at Portland.
6. Datum conversion tables to CRD provided by Port of Portland.
7. Ordinary Low Water elevation provided by USACE.
8. Ordinary High Water elevation provided by Port of Portland.

Existing Piers

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TERMINAL 4 EARLY ACTION
EE/CA REPORT

REMOVAL ACTION AREA PLAN

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FIGURE
P-3

DWG NAME: G:\project\Clients\BBL\Terminal 4\t4_036 (EECA 1-3).dwg
DATE: 12/07/04 5:26pm