5.7 Fish

Fish and fish habitat are important resources of the Columbia River. They include fish listed as threatened and/or endangered under federal law and species of concern under state regulations. Resident and anadromous\textsuperscript{1} fish species support important tribal, commercial, and recreational fisheries and are integral to healthy freshwater and marine ecosystems.

This section describes fish in the study area and the impacts on fish that could result from construction and operation of the proposed export terminal.

5.7.1 Regulatory Setting

Laws and regulations relevant to fish are summarized in Table 5.7-1.

<table>
<thead>
<tr>
<th>Regulation, Statute, Guideline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td></td>
</tr>
<tr>
<td>Endangered Species Act (16 USC 1531 et seq.)</td>
<td>The federal Endangered Species Act of 1973, as amended, provides for the conservation of species that are listed as threatened and endangered and the habitat upon which they depend. Section 7 of the federal Endangered Species Act requires that federal agencies initiate consultation with USFWS and/or NMFS. This will ensure the federal action is not likely to jeopardize the continued existence of any listed threatened or endangered animal species or result in the destruction or adverse modification of designated critical habitat.</td>
</tr>
<tr>
<td>Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267)</td>
<td>Requires fishery management councils to include descriptions of essential fish habitat and potential threats to essential fish habitat in all federal fishery management plans. Also requires federal agencies to consult with NMFS on activities that may adversely affect essential fish habitat.</td>
</tr>
<tr>
<td>State</td>
<td></td>
</tr>
<tr>
<td>Washington State Growth Management Act (36.70A RCW)</td>
<td>Defines a variety of critical areas, which are designated and regulated at the local level under city and county critical areas ordinances. These critical areas may include shorelines or portions of fish habitat.</td>
</tr>
<tr>
<td>Washington State Shoreline Management Act (90.58 RCW)</td>
<td>Requires cities and counties (through SMPs) to protect shoreline natural resources.</td>
</tr>
<tr>
<td>Washington State Hydraulic Code (WAC 220-660)</td>
<td>Protects fish life. WDFW issues a hydraulic project approval for certain construction projects or activities in or near state waters.</td>
</tr>
</tbody>
</table>

\textsuperscript{1} Anadromous describes a life history of migration between fresh water and salt water. Reproduction and egg deposition occur in fresh water while rearing to the adult stage occurs in the ocean.
### Regulation, Statute, Guideline

<table>
<thead>
<tr>
<th>Regulation, Statute, Guideline</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Water Act Section 401 Water Quality Certification</td>
<td>Ensures compliance with state water quality standards and other aquatic resources protection requirements under Ecology's authority as outlined in the federal Clean Water Act.</td>
</tr>
</tbody>
</table>

### Local

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cowlitz County Critical Areas Ordinance (CCC 19.15)</td>
<td>Regulates activities within and adjacent to critical areas, including those that support fish and fish habitat.</td>
</tr>
<tr>
<td>Cowlitz County Shoreline Master Program (CCC 19.20)</td>
<td>Regulates development within shoreline jurisdiction, including the shorelines of the Columbia River, a Shoreline of Statewide Significance.</td>
</tr>
<tr>
<td>City of Longview Shoreline Master Program (Off Site-Alternative only)</td>
<td>The City’s SMP consists of environmental designations for the shoreline segments and goals, policies, and regulations applicable to uses and modifications within the Shoreline Management Zone.</td>
</tr>
<tr>
<td>City of Longview Critical Areas Ordinance (LMC 17.10.140) (Off-Site Alternative only)</td>
<td>Regulates activities within and adjacent to critical areas, including those that support fish and fish habitat.</td>
</tr>
</tbody>
</table>

Notes:


### 5.7.2 Study Area

The study areas for the On-Site Alternative and Off-Site Alternative are described below. These study areas are based on the Corps’ *NEPA Scope of Analysis Memorandum for Record* (MFR) (2014) and adjusted to reflect groundwater characteristics in and near the project areas.

#### 5.7.2.1 On-Site Alternative

The study area for direct impacts on fish includes the Columbia River 3.92 miles upriver and downriver of the project area, measured from the two proposed docks (Figure 5.7-1), to account for elevated underwater noise levels associated with project-related pile-driving activities. This study area accounts for the area where noise from construction or operation of the On-Site Alternative could affect fish.

The study area for indirect impacts on fish includes the direct impacts study area plus the area of the Columbia River extending downriver from the project area to the landward line of the territorial sea (i.e., a line between the western-most end of the north and south jetties), from here on referred to as the mouth of the Columbia River (Figure 5.7-2). This study area includes shallow-sloping beaches along the river on which fish could be stranded by the wakes of passing vessels.
Figure 5.7-1. On-Site Alternative Direct Impacts Study Area
Figure 5.7-2. Fish Indirect Impacts Study Area
5.7.2.2 Off-Site Alternative

The direct impacts study area for the Off-Site Alternative is similar to the On-Site Alternative direct impacts study area. The direct impacts study area extends a distance of approximately 3.92 miles upriver and downriver in the Columbia River (measured, respectively, from the upriver and downriver extents of the proposed docks at the Off-Site Alternative) (Figure 5.7-3).

Similar to the On-Site Alternative, the study area for indirect impacts on fish has been expanded to include the Columbia River downriver from the Off-Site Alternative to the Columbia River mouth to accommodate an analysis of the potential impacts of fish stranding on shallow sloping beaches (Figure 5.7-2).

5.7.3 Methods

This section describes the sources of information and methods used to evaluate the potential impacts on fish associated with the construction and operation of the proposed export terminal.

5.7.3.1 Information Sources

The following sources of information were used to identify the potential impacts of the On-Site Alternative, Off-Site Alternative, and No-Action Alternative on fish in the study areas. These sources focus on fish, fish habitat, and aquatic resources in the study areas and, specifically, the aquatic and shoreline habitat adjacent to the project area.

- One site visit conducted by ICF International fish biologists on January 29, 2014.
- National Oceanic and Atmospheric Administration (NOAA) Fisheries West Coast Region species list and listing packages (2014a, 2014b).
- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) geographic information system (GIS) data (2015a) and SalmonScape data (2015b). The Priority Habitat and Species Program is fulfilled by WDFW to provide important fish, wildlife, and habitat information to local governments, state and federal agencies, private landowners, consultants, and tribal biologists for land use planning purposes.
- Washington Department of Natural Resources, Natural Heritage Program (2014).
- Fish Passage and Timing Data Columbia River Data Access in Real Time, Columbia Basin Research, University of Washington (juvenile and adult fish passage) (Columbia River Research 2014).

A detailed list of references is provided in the NEPA Fish Technical Report (ICF International 2016a).
Figure 5.7-3. Off-Site Alternative Direct Impacts Study Area
5.7.3.2 Impact Analysis

The following methods were used to identify the potential impacts of the proposed export terminal on fish in the study areas. For more information on these methods, see the NEPA Fish Technical Report. For direct impacts, the analysis assumes best management practices were incorporated into the design, construction, and operations of the terminal. More information about best management practices can be found in Chapter 8, Minimization and Mitigation, and Appendix H, Export Terminal Design Features.

Identifying Resources in the Study Area

The following species and habitat characteristics were identified and quantified, where possible.

- Documented species occurrences
- Species likely to occur in the study area
- Suitable habitat conditions

Impacts on fish species are qualitatively described because fish are generally mobile and their presence and abundance in the study area cannot be quantitatively predicted at a specific location or time. Where appropriate, species sensitivity to construction or operation impacts is discussed.

Assessing Noiise Impacts

Federal agencies have established interim criteria to protect fish from underwater noise generated by pile-driving (Fisheries Hydroacoustic Working Group 2008; Carlson et al. 2007). The criteria indicate that sound pressure levels of 150 decibels (dB) \(\text{RMS}\) could result in behavioral changes, while sound pressure levels of 206 dB \(\text{PEAK}\) could result in injury to fish. Specific dB criteria for Endangered Species Act (ESA)-listed fish are provided in Table 5.7-2. The National Marine Fisheries Service (NMFS) assumes that a 12-hour recovery period with no exposure to sound is necessary to return to appropriate cumulative sound levels (Stadler and Woodbury 2009).

The criteria for sound pressure levels and underwater noise thresholds described above were applied to proposed pile-driving activities for the On-Site Alternative and Off-Site Alternative. Because the project area is similar to the Columbia River Crossing (the site of a proposed interstate crossing of the Columbia River, between Portland, Oregon and Vancouver, Washington), underwater noise characteristics from pile-driving at that site were used to calculate per-pile levels of underwater noise for the 36-inch-diameter pile used for the On-Site Alternative and the Off-Site Alternative (Grette Associates 2014b, 2014c, respectively).

A complete description of noise impact models, calculations, and assessments is provided in the NEPA Fish Technical Report. Further, project-related vessels could generate underwater noise levels that could cause disturbance, as measured by the applicable noise thresholds for fish. Vessel noise levels were obtained from available literature, and are described in the NEPA Fish Technical Report.
Table 5.7-2. Underwater Sound-Level Thresholds for Endangered Species Act-Listed Fish

<table>
<thead>
<tr>
<th>Species</th>
<th>Impact Type</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Listed Fish&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Injury, cumulative sound (fish ≥2 grams): onset of TTS (auditory response), with onset of auditory tissue damage and nonauditory tissue damage with increasing cumulative sound</td>
<td>187dB&lt;sub&gt;SELcum&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>Injury, cumulative sound (fish &lt;2 grams): similar to above, onset of nonauditory tissue damage occurs at lower sound levels with smaller fish</td>
<td>183dB&lt;sub&gt;SELcum&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>Injury, single strike: onset of TTS and auditory tissue damage from single strike</td>
<td>206dB&lt;sub&gt;PEAK&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>Behavioral Disruption</td>
<td>150dB&lt;sub&gt;RMS&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

Notes:
<sup>a</sup> Injury thresholds are based on interim criteria that were developed for salmonids based on data specific to hearing generalists with swim bladders (Carlson et al. 2007). NMFS also applied these thresholds to other listed fish with swim bladders (e.g., green sturgeon) and sometimes conservatively to fish without swim bladders (e.g., eulachon). Injury descriptions are based on information summarized in Carlson et al. (2007).


TTS = temporary threshold shift; a temporary shift in auditory threshold, such as temporary hearing loss

DB = decibel; a logarithmic unit used to express the ratio of two values of a physical quantity, often power or intensity

SELcum = sound exposure level; metric of acoustic events, often used as an indication of the energy dose.

PEAK = The instantaneous maximum overpressure or underpressure observed during each pulse during pile-driving.

RMS = root mean square; the square root of the sound energy divided by the impulse duration. Essentially, the average of the PEAK energy measured over time.

5.7.4 Affected Environment

This section describes the environment in the study areas related to fish potentially affected by the proposed export terminal.

5.7.4.1 On-Site Alternative

This section describes the affected environment specific to On-Site Alternative study areas related to fish.

The study areas have been affected by extensive modifications for flood control, industrial development, and deep draft vessel traffic. The lower Columbia River is deeper than it was historically because of construction and periodic maintenance dredging of the federal navigation channel and berthing areas along the river. The hydrologic regime and water temperature have been altered by the operation of dams throughout the Columbia River basin. River flows can reverse direction when river flows are low and incoming tides large. Saltwater does not intrude as far upriver as the study area and the water remains fresh through the tidal cycle. The study area is considered a high energy environment, characterized by strong currents, active bedload transport, and variable patterns of sediment of deposition and erosion (Grette Associates 2014c).

Floodplain habitats have been disconnected from the riverine environment and in some cases eliminated. Extensive shoreline armoring and protection, overwater structures, and development in adjacent upland and riparian zones have substantially degraded habitat conditions and altered habitat-forming processes, resulting in corresponding changes to the biological communities associated with these habitats.
The Columbia River estuary extends upstream from the mouth of the Columbia River to the Bonneville Dam (Simenstad et al. 2011). It has been considerably degraded from past use due to diking and filling and from water withdrawal for agricultural, municipal, and industrial purposes. The estuary is also influenced by a number of physical structures (e.g., jetties, piles, pile dikes, bulkheads, revetments, and docks) that contribute to its overall degradation. Habitat-forming processes in the estuary have also been altered by loss of upriver sediment input (now constrained behind upriver dams), changes in flow patterns that move sediments and modify landforms, and channel deepening and dredging.

5.7.4.2 Aquatic Habitat Types

The aquatic habitat in the study area is discussed in terms consistent with habitat equivalency analysis (HEA) model, which describes habitat quality in the context of habitat availability and suitability as a function of water depth and physical attributes. The aquatic portion of the study area adjacent to the project area is composed of three broad habitat types (Grette Associates 2014a): the active channel margin (ACM), the shallow water zone (SWZ), and the deepwater zone (DWZ). Although not technically an aquatic habitat, the riparian zone is discussed because of its interaction with aquatic habitats, as the riparian zone is the transition zone between aquatic and upland/terrestrial habitats. Habitat type locations associated with the On-Site Alternative are provided in Figure 5.7-4.

Riparian Zone

The riparian zone includes lands extending approximately 200 feet landward from the ordinary high water mark (OHWM). Shoreline armoring and Consolidated Diking Improvement District (CDID) #1 levees have contributed to a low habitat complexity, artificially steepened the upper shoreline, and largely cut off floodplain connectivity. Landward of the shoreline, most of the riparian area has been so heavily modified there is little remaining habitat function (Grette Associates 2014a). Relative to shoreline areas with intact riparian habitat (e.g., Lord Island, immediately across the river), shoreline habitat at the On-Site Alternative location is low value (Grette Associates 2014a).

Active Channel Margin

The ACM is defined as the shoreline and nearshore edge habitat. The ACM near the proposed docks covers approximately 25 acres and extends from 25 to 350 feet offshore with a maximum depth of about 11 feet, based on OHWM of +11.1 feet Columbia River Datum (CRD) (Figure 5.7-2). Water levels in the ACM fluctuate continuously. Portions of the ACM are periodically dewatered by tidal influence and river flow conditions, with the extent and duration of exposure dependent on site-specific topography. Habitat functions in the ACM are strongly influenced by the condition of the shoreline and adjacent riparian zone. The shoreline in this area is highly modified by levees and riprap armoring that includes scattered large woody debris.

---

2 Habitat equivalency analysis is a tool that can be used to estimate habitat gains and losses across a range of habitat types

3 Columbia River Datum (CRD) is a vertical datum that is the adopted fixed low water reference plane for the lower Columbia River. It is the plane of reference from which river stage is measured on the Columbia River from the lower Columbia River up to Bonneville Dam, and on the Willamette River up to Willamette Falls.
Figure 5.7-4. Aquatic Habitat Types Potentially Affected by the On-Site Alternative
Shallow Water Zone

The SWZ includes the fully inundated near-shore zone extending waterward from the ACM. The SWZ covers approximately 34 acres adjacent to the proposed docks and extends from approximately 25 to 500 feet offshore with maximum depths ranging from 11 to 31 feet, based on OHWM of +11.1 feet CRD. The bottom is primarily flat or shallow sloping substrate, with some moderate slopes out to depths of about 25 feet, where the slope becomes markedly steeper. The substrate consists primarily of silty river sand with little organic matter (Grette Associates 2014a).

Deepwater Zone

The DWZ encompasses approximately 115 acres in the project area, adjacent to the proposed docks, extending waterward from the edge of the SWZ, beyond 31 feet deep, based on OHWM of +11.1 feet CRD. At approximately 450 feet from the shore, this zone is about 31 feet deep; at 1,200 feet from shore, it reaches 56 feet deep. The DWZ is a dynamic environment, characterized by relatively high flows (high water velocity) and sediment transport. Sediments are composed of fine grain sands with little to no gravel or cobble for structure (Grette Associates 2014a).

5.7.4.3 Focus Fish Species

Fish species of special interest include federally and state-listed threatened and endangered fish and their designated critical habitat, as well as species of commercial, recreational, or cultural importance. Table 5.7-3 outlines the focus fish species, the listing status of each species (i.e., state and federal), habitat types these species typically occupy, and their seasonal occurrence in the study area. Other common native and introduced fish species also occur in the study area. Detailed information about specific fish species can be found in the NEPA Fish Technical Report.

Salmon and Trout

Eight threatened or endangered salmon evolutionarily significant units (ESUs), five threatened steelhead distinct population segments (DPSs), one threatened bull trout DPS, and their designated critical habitats occur in the study area (Table 5.7-3) (Bottom et al. 2008; National Marine Fisheries Service 2011). An ESU is defined as a population of organisms considered distinct for purposes of conservation. A DPS is defined as the smallest division of a taxonomic species permitted to be protected under the ESA. In addition, essential fish habitat (EFH) has been designated for Chinook and coho salmon in the lower Columbia River. EFH includes those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity, per the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act. The Columbia River estuary is used primarily as migratory and rearing habitat by salmon, steelhead, and bull trout (salmonid), and no salmonid spawning takes place in the study areas. Adult anadromous salmonids travel through the estuary and lower river relatively quickly during their migration to upriver spawning grounds, remaining primarily in offshore deepwater habitats. In contrast, juvenile salmonids use a wider variety of habitats and exhibit more variable downriver migration speed, taking advantage of shallow water and ACM for foraging and seeking cover.
## Table 5.7-3. Status of Focus Species and Seasonal Presences in the Study Area

<table>
<thead>
<tr>
<th>Species, ESU/DPS</th>
<th>Federal Statusa</th>
<th>Life Stage</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td>A b</td>
<td>S b</td>
<td>D b</td>
<td>A</td>
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<tr>
<td>Chinook Salmon</td>
<td></td>
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<td></td>
<td></td>
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<td>A</td>
</tr>
<tr>
<td>Snake River fall-run ESU</td>
<td>T</td>
<td>Adults</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<td>Subyr</td>
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<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lower Columbia River ESU</td>
<td>T</td>
<td>Adults</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
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<td>Subyr</td>
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<tr>
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<td>A</td>
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<td>Lower Columbia River ESU</td>
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<td>Cutthroat Trout</td>
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<td>Eggs/Larvae</td>
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<tr>
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</tbody>
</table>

Notes:

- **T** denotes federally threatened (no Endangered in this table), “NL denotes Not Listed, SOC denotes Species of Concern.
- **A**, **S**, and **D** represent the HEA habitat categories of ACM, SWZ, and DWZ; see Grette (2014c) Section 3.2.3.1 for additional information.
- **X** denotes expected or potential presence; see Grette Associates (2014c), Section 3.3 for additional information.
- “...” denotes expected presence but low relative abundance; see Grette Associates (2014c), Section 3.3 for additional information.
- The Middle Columbia River DPS includes a very small proportion of winter-run fish (Klickitat River, Fifteen-Mile Creek); because passage data at Bonneville Dam indicate that the vast majority of steelhead have passed the dam by early October, it is assumed that this includes winter steelhead spawning above it.

ESU = Evolutionary Significant Unit; DPS = Distinct Population Segment; Subyr = subyearling; Yrlng = yearling.
General salmon reproductive strategies can be divided into two groups: stream-rearing and ocean-rearing. Stream-rearing fish tend to spend extended periods of time, usually more than a year, rearing in fresh water before emigrating to the ocean. Examples of stream-type fish are steelhead, coho and spring-run Chinook salmon. In contrast, ocean-type juvenile salmonids tend to return to the ocean in the same year they were spawned. Examples of ocean-type fish are chum salmon, and fall-run Chinook salmon. These strategies affect how each population uses the estuary and how it may be affected by the On-Site Alternative.

Designated critical habitat for federally protected salmonids in the study area consists of two primary elements: migration corridors and estuarine areas. Additionally, the Columbia River is also EFH, as defined by the Magnuson-Stevens Fishery and Management Conservation Act for Chinook and coho salmon. EFH for Pacific salmon is defined as those waters and substrate necessary for salmon production needed to support a sustainable salmon fishery and salmon contributions to a healthy ecosystem.

A fully functioning ACM provides natural cover (large woody debris, undercut banks, overhanging vegetation), shoreline complexity, shade, submerged and overhanging large woody debris, logjams, and aquatic vegetation. All of these elements are identified in the primary constituent elements (PCEs) of critical habitat for ESA-listed salmon and steelhead, as well as bull trout (Grette Associates 2014a). PCEs are defined as those physical and biological features that a species needs to survive and reproduce. The ACM provides important habitat for juvenile salmon, with different species using different habitat types at different life stages. Table 5.7-3 identifies the seasons when salmon and steelhead species could be present in the ACM portion of the study areas.

The SWZ is used primarily as a migratory corridor by adult salmon and steelhead and as foraging habitat by larger juveniles that are capable swimmers in open water. Juvenile Chinook salmon, and sockeye salmon and steelhead smolts are typically found in deeper open water in the SWZ, where they forage on phytoplankton, invertebrates, and small fish (Bottom et al. 2008; Carter et al. 2009). Juvenile Chinook salmon are most commonly present from March through July but juveniles of certain runs may be found in the SWZ during any month of the year. Juvenile coho salmon and steelhead are less likely to be found in the shallower areas but are abundant in deepwater offshore habitats during their outmigration period (Roegner and Sobocinski 2008), indicating they likely occur in the deeper areas of the SWZ.

The DWZ provides a migratory corridor for adult salmon and steelhead and foraging and migratory habitat for larger juvenile Chinook salmon, coho salmon, and sockeye salmon and steelhead smolts pursuing phytoplankton, invertebrates, and small fish (Bottom et al. 2008; Carter et al. 2009; Roegner and Sobocinski 2008). Generally, juvenile salmonids do not reside in specific habitats in the lower Columbia River for extended periods, remaining in a given area for just a day or two before moving downriver to new suitable habitats (Bottom et al. 2008; Johnson et al. 2003). Juvenile and adult salmon and steelhead are likely to be found in the DWZ during their respective migration and rearing periods (Table 5.7-3) as outmigrating salmonids (particularly stream type) tend to use deepwater (Carter et al. 2009).
**Bull Trout (Char)**

Columbia River bull trout are listed as threatened, and there is one extant population in the Lewis River subbasin, which drains to the lower Columbia River below Bonneville Dam. Bull trout migrate to the mainstem Columbia River to rear, overwinter, or migrate to and from spawning areas. Subadults may occur in the study area throughout the year in shallow rearing habitats of the ACM and SWZ while adults are more likely to occur in the deeper areas of the SWZ and the DWZ (U.S. Army Corps of Engineers 2004).

**Eulachon**

Eulachon are small anadromous fish in the smelt family (*Osmeridae*), sometimes known as Columbia River smelt (among other names), that spawn in coastal rivers and migrate to the ocean to rear to adulthood. The lower Columbia River up to Bonneville Dam and the lower reaches of those tributary streams that provide potential spawning habitats (i.e., Grays, Elochoman, Cowlitz, Kalama, Lewis and Sandy Rivers) have been designated as critical habitat (76 Federal Register [FR] 65324).

Currently, the lower mainstem Columbia River and the Cowlitz River support the majority of eulachon production in the system (Gustafson et al. 2010). However, in years of relative abundance, spawning occurs broadly in the tidally influenced portions of the Columbia River and its tributaries (Grette Associates 2014c).

WDFW and ODFW conducted plankton tows to sample for eulachon eggs and larvae between the Port of Longview above Barlow Point and the channel below the Cowlitz River mouth including four sample sites offshore in the vicinity of the project area (Mallette 2014). Peak larval abundance occurred in mid-March during two of the three survey years and in late April/early May in the third (Mallette 2014). As part of a related one-time sampling effort, eulachon eggs/larvae were documented in plankton tows at six sample sites (inshore and offshore) near the project area between river miles 62.8 and 64.0 in February 2012 (Mallette 2014: Report B). Eggs could be present from December through April; however, peak of spawning season is usually in February or March. Larval eulachon, particularly from spawning aggregations in the Cowlitz River, likely pass through the study area as they are transported downriver. Further, it is likely that at least limited spawning occurs in the mainstem Columbia River, as documented on the Oregon side of the Columbia River by Mallette (2014). Mallette (2014) found the greatest numbers of eulachon larvae were found in samples collected well downstream of the Lewis, Kalama, and Cowlitz rivers and upstream of the Elochoman (rivers with known eulachon spawning). While the relatively distant proximity of sampling events to known spawning areas does not discount the possibility that larvae in samples may be the product of spawning in these tributaries, Mallette (2014) concluded that these findings highlight the potential for at least limited spawning in the mainstem Columbia River.

Adult eulachon could arrive in the study area as early as November, although most adults would migrate through the study area during peak spawning between February and March. Eggs from early spawners could be transported with currents from the tributaries downriver to portions of the study area where suitable incubation conditions exist (i.e., sand waves) shortly thereafter. Emergent larvae could be present in the study area as early as December. However, based on the timing of peak spawning, and because incubation occurs for 1 to 2 months (Grette Associates 2014b), peak larval transport has been shown to occur between mid-March and early May (Mallette 2014).
Sturgeon

Both green and white sturgeon may be present in the deepwater habitats of the study area as adults and subadults. Two green sturgeon DPSs occur in the lower Columbia River. While this species does not spawn in the Columbia River or its tributaries, subadult and adult green sturgeon from all major spawning populations use the lower Columbia River and other coastal estuaries in Oregon and Washington for holding habitat (i.e., areas where fish hold and feed) in the summer and early fall (Adams et al. 2002; Lindley et al. 2011; Moser and Lindley 2007). Sturgeon are most commonly found in association with the bottom, where they feed on a mixture of aquatic insects and benthic (i.e., bottom dwelling) invertebrates (Adams et al. 2002; Independent Scientific Review Panel 2013). The water depth preferences of white sturgeon indicate this species is most likely to be found in the DWZ, but individuals may also be present in the SWZ and, infrequently, in the ACM. The DWZ near the proposed docks does not provide suitable substrates for white sturgeon spawning or larval rearing, so these life stages are unlikely to occur for extended periods in this area. In contrast, juvenile white sturgeon are found throughout the lower Columbia River and use a wide variety of habitats, including both main-channel and off-channel areas. They are most commonly found at depths greater than 33 feet (Independent Scientific Review Panel 2013).

Lamprey

Lamprey are primitive anadromous fish that spend their adult lives in the ocean but return to freshwater habitats for spawning and larval rearing. Two species, Pacific and river lamprey, spawn in tributaries to the Columbia River and migrate through the study area as adults and juveniles. Adults migrate through the lower Columbia River from March through October on their return to spawning tributaries (Columbia River Research 2014). Adult lamprey ascend rivers by swimming upriver briefly, sucking to rocks, resting, and then proceeding. Larval lamprey (ammocoetes) hatch after 2 to 3 weeks and are dispersed downriver by currents to slack-water areas with soft substrates, where they settle in sediments. The larval lamprey burrow into soft substrate where they may reside for 3 to 8 years as filter feeders. Late in the larval lamprey’s life stage, unknown factors trigger metamorphosis, when larval lamprey become juvenile lamprey. During late winter or early spring, juvenile lamprey migrate to the ocean where they mature. The study area lacks suitable spawning substrates for either species. Larval, juvenile and adult lamprey may be present in the SWZ and DWZ during their respective migration periods (Table 5.7-3).

Nonfocus Fish

The nonfocus fish (Table 5.7-4) are important food fish (harvested commercially and recreationally), game fish (harvested recreationally), or on Washington’s PHS list. Two of the species, mountain whitefish (*Prosopium williamsoni*) and leopard dace (*Rhinichthys falcutus*), are on Washington’s PHS list as state candidate species. Both species are widely distributed in the Columbia and Frasier River basins. The remainder of the species in this group are important as commercial or recreational species. Most are abundant and widely distributed in the system, including several introduced species. Some are known predators of juvenile salmonids, such as largemouth bass, northern pikeminnow, smallmouth bass, striped bass, and walleye.
### Table 5.7-4. Nonfocus Fish Species that Could Occur in the Study Area

<table>
<thead>
<tr>
<th>Species</th>
<th>Reason for Interest</th>
<th>Native or Introduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel catfish (Ictalurus punctatus)</td>
<td>WDFW game fish</td>
<td>I</td>
</tr>
<tr>
<td>Common carp (Cyprinus carpio)</td>
<td>WDFW food fish</td>
<td>I</td>
</tr>
<tr>
<td>Largemouth bass (Micropterus salmoides)</td>
<td>WDFW game fish</td>
<td>I</td>
</tr>
<tr>
<td>Leopard dace (Rhinichthys falcatus)</td>
<td>WDFW PHS</td>
<td>N</td>
</tr>
<tr>
<td>Mountain sucker (Catostomus platyrhuchus)</td>
<td>WDFW PHS, WDFW game fish</td>
<td>N</td>
</tr>
<tr>
<td>Mountain whitefish (Prosopium williamsoni)</td>
<td>WDFW game fish</td>
<td>N</td>
</tr>
<tr>
<td>Northern pikeminnow (Ptychocheilus oregonensis)</td>
<td>WDFW game fish</td>
<td>N</td>
</tr>
<tr>
<td>Peamouth (Mylocheilus caurinus)</td>
<td>WDFW game fish</td>
<td>N</td>
</tr>
<tr>
<td>Perch (family Percidae)</td>
<td>WDFW game fish</td>
<td>I</td>
</tr>
<tr>
<td>Shad (subfamily Alosinae)</td>
<td>WDFW food fish</td>
<td>I</td>
</tr>
<tr>
<td>Smallmouth bass (Micropterus dolomieu)</td>
<td>WDFW game fish</td>
<td>I</td>
</tr>
<tr>
<td>Suckers (family Catostomidae)</td>
<td>WDFW game fish</td>
<td>N</td>
</tr>
<tr>
<td>Sunfish (family Centrarchidae)</td>
<td>WDFW game fish</td>
<td>I</td>
</tr>
<tr>
<td>Striped bass (Morone saxatilis)</td>
<td>WDFW game fish</td>
<td>I</td>
</tr>
<tr>
<td>Walleye (Sander vitreus)</td>
<td>WDFW game fish</td>
<td>I</td>
</tr>
</tbody>
</table>

**Notes:**
WDFW = Washington Department of Fish and Wildlife; PHS = Priority Habitats and Species; I = introduced; N = native

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### Commercial, Tribal, and Recreational Fishing

Commercial, tribal and recreational fisheries in the lower Columbia River are managed by the States of Washington and Oregon, and tribes, subject to the terms of the 2008–2017 *United States v. Oregon* Management Agreement. The agreement establishes tribal harvest allocations and upholds the right of tribes to fish for salmon in their usual and accustomed fishing grounds. Commercial and recreational fishing primarily target hatchery-produced salmon and steelhead, as well as sturgeon and other game fish. Tribal fish resources are discussed in Chapter 4, Section 4.5, *Tribal Treaty Rights and Trust Responsibilities*.

Commercial fisheries in these waters are managed under the Columbia River Compact, a congressionally mandated process that adopts seasons and rules for Columbia River commercial fisheries (National Marine Fisheries Service 2015). The Columbia River Compact consists of the Washington and Oregon Departments of Fish and Wildlife Directors or their delegates, acting on behalf of the Oregon and Washington Fish and Wildlife Commission. The Columbia River Compact is charged by congressional and statutory authority to adopt seasons and rules for Columbia River commercial fishers. When addressing commercial seasons for salmon, steelhead, and sturgeon, the Columbia River Compact must consider the impact of the commercial fishery on escapement, treaty rights, and sport fisheries, as well as the impact on species listed under the federal ESA. Although the Columbia River Compact has no authority to adopt sport fishing seasons or rules, its inherent responsibility is to address the allocation of limited resources among users. This responsibility has become increasingly demanding in recent years. The Columbia River Compact can be expected to be more conservative than in the past when considering fisheries that will affect listed salmon and steelhead (National Marine Fisheries Service 2015).
In Washington, recreational fishing seasons and rules are updated annually and presented in the Washington Sport Fishing Rules pamphlet. Sport fishing seasons are generally established for July 1 through June 30 of the following year. The pamphlet covers all fresh waters and marine waters in Washington, including the lower Columbia River, and establishes the seasons and rules for recreational fishing for finfish and shellfish or seaweed.

**Water Quality Conditions**

Sediment conditions in the study area are generally uniform with slight variations between aquatic habitat types. ACM sediments are primarily sand mixed with silt, SWZ sediments are primarily sand, and DWZ sediments are primarily silt mixed with sand (Grette Associates 2014c). The lower Columbia River is listed as a Washington State 303(d) impaired water and is classified by Ecology as a Category 5 polluted water for dissolved oxygen, Dieldrin (organochlorine insecticide), PCB (polychlorinated biphenyl), and 2,3,7,8 TCDD (tetrachlorodibenzo-p-dioxin), and 4,4,4 DDE (dichlorodiphenyldichloroethylene) (Grette Associates 2014c). The nearest measured water quality impairment (for dioxin and bacteria) occurs approximately 2.5 miles upriver of the project area (Washington State Department of Ecology 2014). Turbidity in the study area is variable based on a number of factors. For example, over 5 days of water quality monitoring for dredging, background levels (upstream of active dredging) ranged from the mid-20s to the mid-60s nephelometric turbidity units (NTUs) at all depths (U.S. Army Corps of Engineers Dredged Material Management Office 2010 in Grette Associates 2014c). Water temperature within the study area ranges from low 40s to low 70s (°F), and while this is slightly warmer than historic values (Bottom et al. 2008), the area is not listed as a Washington State 303(d) impaired water for temperature. Salmonids typically move from habitat areas as temperatures approach 66°F, and the study area habitat within the ACM and upper SWZ likely reaches this threshold and may become unsuitable for juveniles salmonids in the summer months. Refer to the NEPA Water Quality Technical Report (ICF International 2016b) for further information regarding water quality conditions near the project area.

**Fish Stranding**

A growing body of evidence indicates that juvenile salmon and other fish are at risk of stranding on wide, gently sloping beaches because of wakes generated by deep draft vessel passage (Bauersfeld 1977; Hinton and Emmet 1994; Pearson et al. 2006; ENTRIX 2008). Depending on the slope and breadth of a beach, wakes from passing vessels can travel a considerable distance, carrying fish and depositing them on the beach where they are susceptible to stress, suffocation, and predation.

Pearson et al. (2006) published the most detailed study of Columbia River fish stranding completed to date. They evaluated stranding at three sites in the lower Columbia River: Sauvie Island, Barlow Point (adjacent to the project area), and County Line Park. The sites were chosen because prior work had established them as sites with a high risk of stranding (Bauersfeld 1977). Pearson et al. (2006) observed 126 vessel passages, 46 of which caused stranding. From the study, certain sites appear to be more susceptible to stranding than others. For example, the highest occurrence of stranding occurred at Barlow Point, where 53% of the observed passages resulted in stranding. Stranding occurred less frequently at Sauvie Island (37% of the observed passages resulted in stranding) and County Line Park (15% of observed passages resulted in stranding) (Person et al. 2006).
The proposed export terminal would add 840 vessel calls, or round-trips to and from the terminal, or 1,680 one-way transits to Columbia River vessel traffic at full capacity, which would introduce additional permanent risk of fish stranding in the Columbia River. Many factors affect the risk of fish stranding in the lower Columbia River, including but not limited to vessel size, draught and speed, and beach slope and permeability.

5.7.4.4 Off-Site Alternative

The affected environment for the Off-Site Alternative is similar to the On-Site Alternative based on the proximity of the two project areas. This section highlights the differences that exist at the Off-Site Alternative project area.

Aquatic Habitat Types

The aquatic portion of the Off-Site Alternative is a functioning, although somewhat modified, habitat complex (riparian, ACM, SWZ, and DWZ) (Figure 5.7-5) with a varying water-level regime that fluctuates on daily (tidal) and seasonal (discharge) scales. Modifications (e.g., diking, shoreline armoring) and simplifications (e.g., lack of vegetation) limit habitat development, but functional habitat is present in the ACM and SWZ portions of the study area (Grette 2014c).

Riparian

Shoreline armoring and the CDID #1 dike have contributed to what is considered low-complexity aquatic habitat conditions with an artificially steepened upper shoreline area and no floodplain connectivity in the upriver two-thirds of the Off-Site Alternative project area. Landward of the shoreline, ongoing dike maintenance prevents establishment of riparian vegetation (Grette 2014c).

However, the Off-Site Alternative project area includes relatively intact riparian habitat below the toe of the dike. Approximately the middle one-third of the Off-Site Alternative project area contains a band of riparian/wetland habitat, varying from approximately 20 to 140 feet wide, and the downriver one-third contains wide (approximately 250 feet), dense riparian/wetland habitat. Thus, much of the Off-Site Alternative contributes moderate to high levels of biological material (e.g., leaf litter, woody material, insects) to the aquatic environment, as well as shade and other physical functions (Grette 2014c).

Active Channel Margin

The middle and lower portions of the ACM consist largely of unvegetated silty sands that provide shallow water habitat (e.g., 2 to 6 feet deep) during high and low water-level seasons. Specifically, the flats in the ACM provide shallow water foraging and refuge opportunities for juvenile salmon during the early part of the outmigration period, which tends to correspond to high water levels in the Columbia River and its tributaries. This shallow, flat habitat occurs almost exclusively in the downriver portion of the study area, and primarily in the ACM. During low water periods when the ACM is dewatered or very shallow, similar flat habitat in the upper SWZ providing similar function is scarce because the SWZ is more steeply sloped (Grette 2014c).
Figure 5.7-5. Aquatic Habitat Types Potentially Affected by the Off-Site Alternative
Shallow Water Zone

Shallow-water areas provide inherently higher biological function than DWZ habitat. In areas with poor quality riparian habitat (e.g., the upriver one-third of the Off-Site Alternative project area), the overall habitat function of the ACM—and to a lesser extent the SWZ—at the project area is expected to be relatively less than similar areas with intact riparian habitat (Grette 2014c).

Deep Water Zone

Because light penetration is reduced with increased water depth, the quality of benthic habitat in DWZ areas ranks at least ten times lower than that of ACM or SWZ habitats. Though no studies have been conducted at the Off-Site Alternative project area, the quality of DWZ habitat is likely reduced due to the highly dynamic nature of currents acting upon it (Grette Associates 2014a). Areas with dynamic bedload typically express reduced biological productivity due to limited sediment stability and insufficient buildup of detritus and fine material (McCabe et al. 1997). In addition, the potential for benthic invertebrates to successfully colonize areas exposed to strong currents is reduced by the risk of burial associated with accretion and the risk of scouring due to erosion. Therefore, in the context of the HEA model, the quality of habitat in the DWZ portions of the Off-Site Alternative project area would rank low compared to the SWZ areas and those portions of the DWZ not exposed to strong downriver flow.

Columbia River

The existing conditions of the Columbia River within the Off-Site Alternative project area are the same as or similar to those of the On-Site Alternative.

5.7.5 Impacts

This section describes the potential direct and indirect impacts on fish and fish habitat that would result from construction and operation of the proposed export terminal.

5.7.5.1 On-Site Alternative

This section describes the potential impacts that could occur in the study areas as a result of construction and operation of the proposed export terminal at the On-Site Alternative location.

Construction—Direct Impacts

Construction-related activities associated with the On-Site Alternative could result in direct impacts as described below. As explained in Chapter 3, Alternatives, construction-related activities include demolishing existing structures and preparing the site, constructing the rail loop and dock, and constructing supporting infrastructure (e.g., conveyors and transfer towers).

Aquatic Habitat

Construction of the proposed docks would temporarily alter or permanently remove aquatic habitat in the Columbia River adjacent to the project area. A total of 610, 36-inch-diameter steel piles would be placed in-water, permanently removing 0.10 acre (4,312 square feet) of benthic habitat. The majority of this habitat is located in the DWZ, and pile placement would result in the loss of benthic habitat and primary and secondary production from affected benthic habitat.
Benthic organisms within the footprint of individual piles at the time of pile-driving would likely perish.

Existing creosote-treated piles would be removed from portions of two existing timber pile dikes. Removal of approximately 225 lineal feet of pile dike would result in long-term benefits by removing a source of creosote, a mixture of polycyclic aromatic hydrocarbons (PAHs) and other chemicals that are toxic to aquatic organisms (Brooks 1995). However, removal could temporarily increase suspended sediments, resulting in short-term contamination of water and long-term contamination of sediments from creosote piling that have been in place for many years, which may be mobilized during extraction and result in temporary water contamination.

Dredging would permanently alter a 48-acre area of benthic habitat in the DWZ by removing approximately 500,000 cubic yards of benthic sediment to achieve a depth of -43 feet Columbia River Datum, with a 2-foot over dredge allowance. Water depth would be increased by up to 16 feet in the dredge prism (i.e., extent of the area to be dredged). The majority of benthic organisms within the proposed dredge prism would be removed during dredging. Recolonization by organisms would be relatively rapid, and disturbed habitats would return to reference conditions following recolonization by benthic organisms (McCabe et al. 1996). Typically 30 to 45 days are required for benthic organisms to recolonize disturbed environments.

The Applicant has proposed to do the in-water work between August 1 and February 28. The Applicant has proposed to do impact pile-driving between September 1 and December 31; dredging, including flow lane disposal of dredged material, would be performed between August 1 and December 31; and impact pile-driving between September 1 and December 31. While the specific times dredging activities would be allowed by the permitting agencies has not been determined and would not be defined until permits would be issued for the terminal, the Applicant-proposed timing for performing the dredging activities would avoid and minimize impacts on spawning adult, egg, and larval eulachon. Adult eulachon typically enter the Columbia River and tributaries (i.e., Cowlitz, Kalama, Lewis, Sandy, Elochoman), in December and January. Peak spawning migration occurs in February and March. Peak larval abundance occurred in mid-March during two of three survey years and in late April/early May in the third (Mallette 2014). Eggs could be present from mid-November through April; however, dredging activities that occur between August 1 and November 30 would minimize potential impacts on adult eulachon that may spawn within 300 feet of the dredge prism. Limiting dredging activities to August 1 through November 30 would further reduce the potential to affect eulachon spawning or migrating adults.

Dredging and dock construction associated with the terminal could affect habitat that may be suitable for eulachon spawning. Spawning substrates include sand, course gravel, and detrital substrates. Sand substrate occurs within the dredge prism, and is assumed to provide suitable habitat for eulachon spawning. Project-related dredging would affect approximately 48 acres for the On-Site Alternative. Trestle and dock construction would install 610 piles below OHWM, affecting an additional 0.10 acre (4,312 square feet). The dock, with two Panamax-size vessels being loaded simultaneously, would shade approximately 9.83 acres (refer to Operational Direct Impacts, below). The direct impacts study area for the On-Site Alternative is approximately 1,549 acres (Figure 5.7-1). Thus, project-related dredging would modify approximately 3% of the direct impacts study area, while dock construction would permanently affect approximately
0.6% of the direct impacts study area. The extent of this area that may be used by eulachon for spawning is unknown.

During eulachon spawning eggs are deposited through broadcast spawning and attach to the substrate. After approximately 1 month of incubating the eggs hatch into larvae that drift passively downstream to saltwater. It is likely that much of the dredge prism area is used for egg incubation and larval transport/rearing, either from spawning within the dredge prism area or egg drift from areas upstream within the Columbia River, or the Cowlitz River, located approximately 5 miles upstream of the project area.

Eulachon are assumed to occur in the Columbia River adjacent to the project area from December through May. Any project-related work that would occur between December and May could directly affect eulachon. Mitigation would reduce the potential impact by confirming the presence/absence of eulachon, and, if present, coordinating with the fish and wildlife agencies (i.e., NMFS and WDFW) on the appropriate course of action to avoid and minimize potential impacts on eulachon. Sediment sampling from within, adjacent to, and upriver of the project area has demonstrated that in deepwater areas of the Columbia River, sediments are typically composed of silty sands with a low proportion of fines (e.g., silt or mud) and very low total organic carbon. Further, sediments sampled from deepwater areas in the project vicinity have consistently met suitability requirements for flow lane disposal or beneficial use in the Columbia River (Grette Associates 2014c). Thus, it is anticipated sediment within the dredge prism for Docks 2 and 3 would be deemed suitable for flow lane disposal or beneficial use in the Columbia River. However, prior to issuing a Department of the Army permit, the Corps would require the Applicant to conduct site-specific sediment sampling and prepare an agency-approved dredged materials management plan (Grette Associates 2014c). The disposal area for dredged materials is anticipated to be approximately 80 to 110 acres. The actual acreage and specific location of the disposal site would be determined by the permitting agencies and would be based on sediment characteristics (i.e., consistency and density of sediments). Recent authorizations for flow lane disposal of dredged materials in the Columbia River in the vicinity of the project area were generally in or adjacent to the Columbia River navigation channel between approximately river miles 60 and 66 (Grette Associates 2014b). Riparian vegetation at the project area is sparse and degraded. Project construction would not result in measurable impacts on riparian vegetation or habitat conditions.

**Elevated Turbidity**

Removal of piles and the dredging and disposal of riverbed substrate would temporarily increase turbidity. Suspended sediment concentrations near dredging activity do not typically cause gill damage to salmonids (Servizi and Martens 1992; Stober et al. 1981).

Behavioral effects related to increased turbidity are another consideration. Documented behavioral effects of turbidity on fish include avoidance, disorientation, decreased reaction time, increased or decreased predation and increased or decreased feeding activity. However, many fish species (especially estuarine species) have been documented to prefer higher levels of turbidity for cover from predators and for feeding strategies. For example, increased foraging rates for juvenile Chinook salmon were attributable to increase in cover provided by increased turbidity, while juvenile steelhead and coho salmon had reduced feeding activity and prey capture rates at relatively low turbidity levels. Juvenile Chinook salmon were also found to have reduced predator-avoidance recovery time after exposure to turbid water (ECORP Consulting
Thus, while there may be some beneficial behavioral effects from increased turbidity, it is expected that behavioral effects from increased turbidity would generally be negative. Although it is difficult to determine exactly how much of a temporary increase in turbidity would result from the construction activities, increases in suspended sediments are expected to be relatively short term, occurring during in-water construction activities and maintenance dredging. Thus, in-water construction and maintenance activities would not result in chronic sediment delivery to adjacent waters, because sediments would be disturbed only during occasional temporary in-water work.

Construction-related dredging is proposed to occur from August 1 through December 31, when many fish species would be present in the study area.

**Underwater Noise**

Installation of 610 structural steel piles below the OHWM to support the trestle and Docks 2 and 3 would generate underwater noise during pile-driving (Grette Associates 2014b). Most piles would be driven to a depth of 140 to 165 feet below the mudline to provide the necessary resistance to support Docks 2 and 3, the shiploaders, and conveyors (Grette Associates 2014a). The duration of vibratory and impact pile-driving required to install each pile would depend on the depth at which higher-density materials (e.g., volcanic ash or dense sand and gravels) are encountered; shallower resistance would require less vibratory and more pile-driving, while deeper resistance would require more vibratory and less pile-driving.

Pile-driving would occur over two construction seasons, with multiple rigs operating simultaneously between September 1 and December 31. The sequence of pile-driving and the number of pile-driving rigs operating at the same time would be determined during permitting. Each pile would be installed using a vibratory driver until it meets resistance, at which point an impact pile-driver would be used to proof the pile to the necessary weight-bearing capacity. Impact pile-driving would be expected to last 20 to 120 minutes per pile.

Noise attenuation and fish movement models predicted that underwater noise thresholds would be exceeded, resulting in injury or behavior impacts, at distances ranging from 45 feet (single sound strike) to 3.92 miles (cumulative sound). The specific distances and impacts on ESA-listed fish are provided in Table 5.7-5. Because the number of pile strikes per day would be variable, it was assumed that a minimum of 5,000 strikes/day would occur. Increasing pile strikes beyond 5,000 would not affect the distance at which thresholds would be exceeded for all federally protected fish. Predicted noise reduction using confined or unconfined bubble curtains or similar attenuation devices would be at least 9 dB, based on observations at the Columbia River Crossing (David Evans Associates 2011) and at Puget Island (Washington State Department of Transportation 2010).

Underwater sound generated by impact pile-driving could affect fish in several ways, ranging from alteration of behavior to physical injury or mortality. The impact would depend on the intensity and characteristics of the sound, the distance and location of the fish in the water column relative to the sound source, the size and mass of the fish, and the fish’s anatomical characteristics (Hastings and Popper 2005).
Table 5.7-5. Underwater Noise Thresholds and Distances to Threshold Levels

<table>
<thead>
<tr>
<th>Species</th>
<th>Impact Type</th>
<th>Threshold</th>
<th>Distance to Impact Thresholda</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Federally Protected Fish</td>
<td>Injury, cumulative sound (≥2 grams)</td>
<td>187 dBSEL</td>
<td>1,775 feetb</td>
</tr>
<tr>
<td></td>
<td>Injury, cumulative sound (&lt;2 grams)</td>
<td>183 dBSEL</td>
<td>1,775 feetbc</td>
</tr>
<tr>
<td></td>
<td>Injury, single strike</td>
<td>206 dBPEAK</td>
<td>45 feetd</td>
</tr>
<tr>
<td></td>
<td>Behavior</td>
<td>150 dB RMS</td>
<td>3.92 miles</td>
</tr>
</tbody>
</table>

Notes:
- a Impact pile-driving operation, 36-inch steel pile with 9 dB attenuation from use of confined bubble curtain.
- b This represents the point at which the model for distance to threshold for cumulative sound no longer increases with increased pile strikes. For 187 dBSELcum (fish ≥ 2 grams), this is at 5,003 strikes; for 187 dBSELcum (fish >2 grams), this is at 1,992 strikes. The concept of effective quiet makes the 1,775-foot distance applicable to both thresholds and therefore is applicable to fish both greater than and less than 2 grams.
- c Given the On-Site Alternative location and adherence to the proposed in-water work window, most salmonids in the area during construction are assumed to be > 2 grams (187 dBSELcum threshold), except possibly for very early subyearling chum salmon in December.
- d Because the distance to cumulative sound thresholds are greater than the distance to the single-strike sound threshold, this analysis follows the NMFS dual criteria guidance and moves forward solely considering the larger values.

dBSEL = decibels sound exposure level; dBPEAK = decibels at peak sound level; dB RMS = decibels root mean square

Based on calculations of where underwater noise thresholds would be exceeded by pile-driving noise (Section 5.7.3.2, Impact Analysis, Assessing Noise Impacts), the area where cumulative sound levels could reach or exceed the injury threshold (potential injury area) would extend from the proposed trestle and dock to a maximum distance of 1.1 miles along the shoreline (1,775 feet upriver and downriver plus the 2,300-foot length of Docks 2 and 3). The total potential injury area would encompass 0.44 square mile. Although the thresholds were developed for salmonids, they would apply to other fish species. The potential for injury or behavioral effects depends on the amount of time that fish are present in the study area.

Five threatened salmon species could occur in the study area during the in-water work window of September 1 through December 31 (Table 5.7-6). All life history stages of the Snake River spring/summer-run Chinook salmon, upper Columbia River spring-run Chinook salmon, Snake River sockeye salmon, and upper Willamette River steelhead populations units would likely be absent from the study area and not affected by pile-driving. Bull trout are expected to occur infrequently and in very low numbers relative to all other salmonids. The likelihood of bull trout presence at any given time is very low, and the potential for pile-driving activities to affect bull trout is, therefore, considered negligible. According to the USFWS (2002), bull trout in the Lower Columbia River Recovery Unit could have migrated seasonally from tributaries downriver into the Columbia River to overwinter and feed. However, the extent to which bull trout in the Lower Columbia River Recovery Unit currently use the mainstem Columbia River is unknown.
Green sturgeon, eulachon, and salmonids could be present in the study area during the proposed in-water work window. For these species, pile-driving could affect fish migrating in the SWZ and the migrants and residents in the DWZ. Approximately 0.09 (20%) of the 0.44-square-mile potential injury area would be in the SWZ. The risk of injury could be lower for some populations, depending on their abundance or absence during in-water work, but juvenile salmon present as shallow water subyearlings could be at risk of injury. Larger subyearling or yearling individual salmonids could occur in all of the 0.44-square-mile potential injury area.

Adult salmon could migrate upriver through the study area during the proposed in-water work window, but none of the salmon populations spawn in the potential injury area. Chinook salmon, chum salmon, and steelhead migrate approximately 19 to 25 miles per day (Keefer et al. 2004; English et al. 2006; Buklis and Barton 1984). Coho salmon migrate approximately 9 to 20 miles per day (Sandercock 1991). These migration rates suggest that adult salmon would move through the study area relatively quickly, travelling through the potential injury area in approximately 20 to 90 minutes, depending on the species and actual rate of travel. These migration patterns could limit the potential for and duration of exposure; however, adult salmon migrating through the study area could be injured by pile-driving noise. Injuries on adult salmon could include temporary and long-term hearing damage, referred to as Temporary Threshold Shifts (TTS) and Permanent Threshold Shifts (PTS), respectively (Grette Associates 2014b). Exposure to very loud noise, or loud noise for extended periods of time may result in permanent reductions in sensitivity or PTS. Generally, TTS would occur at lower levels than those resulting in auditory tissue damage, which result in PTS. The impact of hearing loss in fish may relate to the fish’s reduced fitness, which may increase the vulnerability to predators or result in a

### Table 5.7-6. Salmonids and Other Fish in the Study Area during the Proposed Work Window (September 1–December 31) by Life Stage

<table>
<thead>
<tr>
<th>Species</th>
<th>Federal Status</th>
<th>Shallow-water Subyearling</th>
<th>Deepwater Subyearling</th>
<th>Deepwater Yearling</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chinook Salmon</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snake River fall-run ESU</td>
<td>T&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Sep–Nov&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sep–Nov&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>Sept–Oct</td>
</tr>
<tr>
<td>Lower Columbia River ESU</td>
<td>T</td>
<td>Sep–Nov&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sep–Dec&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sep–Dec&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sept–Oct</td>
</tr>
<tr>
<td>Upper Willamette River ESU</td>
<td>T</td>
<td>Sep–Nov&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sep–Dec&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Coho Salmon</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Columbia River ESU</td>
<td>T</td>
<td>Sep–Dec&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Sep–Dec&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td>Sept–Dec</td>
</tr>
<tr>
<td><strong>Chum Salmon</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columbia River ESU</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td>Sept–Dec</td>
</tr>
<tr>
<td><strong>Steelhead Trout</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snake River DPS</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td>Sept–Oct</td>
</tr>
<tr>
<td>Upper Columbia River DPS</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td>Sept–Oct</td>
</tr>
<tr>
<td>Middle Columbia River DPS</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td>Sept–Oct</td>
</tr>
<tr>
<td>Lower Columbia River DPS</td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td>Sept–Dec</td>
</tr>
<tr>
<td><strong>Green Sturgeon</strong></td>
<td>T</td>
<td></td>
<td></td>
<td></td>
<td>Sept–Dec</td>
</tr>
<tr>
<td><strong>Eulachon</strong></td>
<td>T</td>
<td>Dec</td>
<td>Dec</td>
<td>Dec</td>
<td>Nov–Dec</td>
</tr>
</tbody>
</table>

Notes:
- T denotes federally threatened (no Endangered in this table).
- Denotes expected presence during the proposed in-water work window; see Grette Associates (2014c).

ESU = Evolutionary Significant Unit; DPS = Distinct Population Segment.
reduced ability to locate prey, inability to communicate, or inability to sense their physical environment (Hastings and Popper 2005). Popper et al. (2005) found fish experiencing TTS were able to recover from varying levels of TTS, including substantial TTS, in less than 18 hours post exposure. Meyers and Corwin (2008) reported evidence that fish can replace or repair sensory hair cells that have been damaged in both the inner ear and lateral line, indicating that fish may be able to recover from PTS over a period of days to weeks. Measures to reduce the risk of TTS and PTS to salmonids includes noise attenuation measures to be implemented during in-water pile-driving activities (i.e., use of confined bubble curtain or similar noise attenuation and implementing a soft-start when initiating pile-driving). See Chapter 8, Minimization and Mitigation, for further information.

Sound pressure levels could exceed the threshold for behavioral impacts up to 3.92 miles from pile-driving activities per the NEPA Fish Technical Report. A line-of-sight rule, meaning that noise may propagate into any area that is within sight of the noise source, is used to determine the extent of noise propagation in river systems. Fish in the potential injury area could exhibit behavioral responses, which could include reduced predator avoidance and foraging efficiency. The injury area for a single-strike would extent approximately 45-feet from the pile-driving activity. Because the potential injury area would be limited to such a small area, it is extremely unlikely that adult fish would experience injury.

**Temporary Shading**

Overwater structures, barges, and vessels required for construction would increase shading to the aquatic environment beneath and adjacent to the structure, which could result in changes to primary productivity, fish behavior, predation and migration. The use of these structures and vessels would primarily be during the in-water construction period for installation of support piling for Docks 2 and 3. Pile-driving activities would likely be more disruptive to fish than the shading created by construction-related barges and vessels, and would likely affect migration and foraging opportunities in the study area to a greater extent.

**Spills and Leaks**

Construction activities could result in temporary water quality impacts from the release of hazardous materials such as fuels, lubricants, hydraulic fluids, or other construction-related hazardous materials. Spills could affect aquatic habitat or fish near the discharge point, resulting in potential toxic acute or subacute impacts that could affect the respiration, growth, or reproduction of the affected fish. A spill would likely be relatively small (e.g., less than 50 gallons) because limited quantities of potentially hazardous materials would be stored and used during construction at the project area. However, a spill could cause impacts on fish based on the location, weather conditions, quantity and material spilled. The potential risks, impacts, and mitigation measures related to water quality are addressed in Section 5.5, Water Quality. Appropriate training and implementation of prevention and control measures would guard against these risks, greatly reducing the potential for these types of impacts.

**Construction—Indirect Impacts**

Construction of the proposed export terminal would not result in indirect impacts on fish because no construction impacts would occur later in time or outside of the direct impacts study area.
Operations—Direct Impacts

Operation of the proposed export terminal at the On-Site Alternative location would result in the following direct impacts. Operations-related activities are described in Chapter 3, Alternatives.

Shading

Overwater structures (Docks 2 and 3 and large vessels) would increase shading to the aquatic environment, which could result in changes to primary productivity as well as fish behavior, predation and migration. Permanent shading could reduce primary productivity by phytoplankton and macrophytes (Carrasquero 2001). Less primary productivity results in less energy for epibenthic communities and ultimately the fish that prey on epibenthic organisms. Shadows may also affect fish migration, prey capture, and predation. Juvenile salmon tend to migrate along the edges of shadows rather than passing through them (Simenstad et al. 1999). Low levels of underwater light are also favorable for predatory fish such as bass and northern pikeminnow to see and capture their prey, including juvenile salmon. Reduction of primary productivity in DWZ habitat would not likely translate to reductions of epibenthic communities, which are more prevalent in SWZ habitat.

Light attenuation could affect fish migration, prey capture and predation. While salmon fry are known to use darkness and turbidity for refuge, they generally migrate along the edges of shadows rather than penetrate them. Foraging opportunities for juvenile fish are generally associated with SWZ habitat, which are expected to provide greater availability of benthic organisms as compared to DWZ habitat. Juvenile salmon primarily migrate in SWZ habitat, although larger juveniles do migrate in DWZ habitat. Juveniles migrating in DWZ habitat are likely migrating relatively quickly and not rearing for extended periods in any particular area. The trestle is the only structure that would generate shade in SWZ habitat. The potential shading created by the trestle would be relatively limited because the trestle is elevated over the OHWM by approximately 8 feet. The height of the trestle would allow light to penetrate beneath the structure and would, therefore, not be expected to have measurable shading impacts on primary productivity or fish behavior, migration, or predation in SWZ habitat.

The trestle would shade 0.3 acre of SWZ habitat, while Docks 2 and 3 and a portion of the trestle would shade 4.83 acres of DWZ habitat. Vessels loading at Docks 2 and 3 during operations would further increase the shading of DWZ habitat. If two Panamax vessels were being loaded simultaneously, they would shade an additional 4.7 acres of DWZ habitat, or 9.83 total shaded acres. The study area (Figure 5.7-1) encompasses approximately 1,300 acres, primarily DWZ habitat. Shading created by Docks 2 and 3 as well as vessels being loaded at the docks would shade approximately 0.8%. Because, juvenile salmon tend to migrate in SWZ habitat, shading of DWZ habitat would likely affect juvenile salmonids to a lesser extent than adults or larger juveniles that tend to migrate in DWZ habitat. Shading of DWZ habitat would have low impacts on primary productivity, as primary productivity tends to be higher in SWZ habitat. Based on the location of Docks 2 and 3 over DWZ habitat, and the relatively small area shaded in relation to the overall study area, the overall shading impact would be low.

The trestle is the only structure that would cross the SWZs where juvenile salmon may be present. The design, orientation (north-south), narrow width (24 feet), and height above the water surface (8 feet) would allow some natural light to pass under the structure during all seasons and limit the potential impacts of shading on fish and fish habitat. The dock and moored vessels would be located over DWZ habitats, where shaded habitat could provide suitable
conditions for larger predatory fishes and piscivorous (i.e., fish-eating) birds. Piles and moored vessels may also create flow conditions favorable for predatory fishes. The extent or magnitude to which an increase in overwater surface area could alter the predator–prey relationship in the study area is unknown, but it is assumed that the relationship would change and an increase in predation would be likely.

**Spills and Leaks**

Operations activities on land as well as in- and over-water could result in temporary water quality impacts from a release of hazardous materials such as fuels, lubricants, hydraulic fluids, or other chemicals. Spills could affect aquatic habitat or fish that occur near the discharge point, resulting in potential toxic acute or subacute impacts that could affect the respiration, growth, or reproduction of the affected fish. Overall, it is assumed that a spill would be relatively small (e.g., less than 50 gallons) because limited quantities of potentially hazardous materials would be stored and used during operations at the project area. Refueling of vehicles during operations would occur off site at approved refueling stations, or fuel would be delivered to the site by a refueling truck (capacity of 3,000 to 4,000 gallons). Refueling trucks are required to carry appropriate spill response equipment, thereby reducing the potential risk and impact associated with a fuel spill. Vessel bunkering (i.e., a vessel receiving fuel while at the dock) would not occur at the project area. Thus, there would be no increased risk of spills associated with vessel transferred associated with the On-Site Alternative. The potential risks, impacts, and mitigation measures related to water quality are addressed in Section 5.5, *Water Quality*. Refer to Chapter 4, Sections 4.6, *Hazardous Materials*, and 4.7, *Energy*, as well as Chapter 6, Section 6.4, *Vessel Transportation*, for more information related to fuel and refueling activities associated with the On-Site Alternative. Similarly, appropriate training and implementation of prevention and control measures would guard against these risks, greatly reducing the potential for these types of impacts.

**Coal Spills**

Direct impacts on the natural environment from a coal spill during operations of the terminal could occur. Direct impacts resulting from a spill during coal handling at the terminal would likely be minor because the amount of coal that could be spilled would be relatively small. Also, impacts would be minor because of the absence of aquatic environments in the project area and the contained nature and features of the terminal (e.g., enclosed belt conveyors, transfer towers, and shiploaders). Potential physical and chemical effects of a coal release on the aquatic environments that occur adjacent to the terminal are described below.

Aquatic environments could potentially be affected by a coal spill, both physically and chemically. A coal spill could have physical effects on aquatic environments, including abrasion, smothering, diminished photosynthesis, alteration of sediment texture and stability, reduced availability of light, temporary loss of habitat, and diminished respiration and feeding for aquatic organisms. The magnitude of these potential impacts would depend on the amount and size of coal particles suspended in the water, duration of coal exposure, and existing water clarity (Ahrens and Morrisey 2005). Therefore, the circumstances of a coal spill, the existing conditions of a particular aquatic environment (e.g., pond, stream, wetland), and the physical effects on aquatic organisms and habitat from a coal spill would vary.
Similarly, cleanup of coal released into the aquatic environment could result in temporary impacts on habitat, such as smothering, altering sediment composition, temporary loss of habitat, and diminished respiration and feeding for aquatic organisms. The recovery time required for aquatic resources would depend on the amount of coal spill and the extent and duration of cleanup efforts, as well as the environment in which the incident occurred. It is unlikely that coal handling in the upland portions of the terminal would result in a spill of coal that would affect the Columbia River. This is unlikely because the rail loop and stockpile areas would be contained, and other areas adjacent to the terminal are separated from the Columbia River by an existing levee, which would prevent coal from being conveyed from upland areas adjacent to the rail loop to the Columbia River. Coal could be spilled during shiploading operations as a result of human error or equipment malfunction. However, such a spill would likely result in a limited release of coal into the environment due to safeguards to prevent such operational errors, such as start-up alarms, dock containment measures (i.e., containment “gutters” placed beneath the docks to capture water and other materials that may fall onto and through the dock surface) to contain spillage /rainfall/runoff, and enclosed shiploaders.

The chemical effects on aquatic organisms and habitats would depend on the circumstances of a coal spill and the existing conditions of a particular aquatic environment (e.g., stream, lake, wetland). Some research suggests that physical effects are likely to be more harmful than the chemical effects (Ahrens and Morrisey 2005).

A recent coal train derailment and coal spill in Burnaby, British Columbia, in 2014, and subsequent cleanup and monitoring efforts provide some insight into the potential impacts of coal spilled in the aquatic environment. Findings from spill response and cleanup found there were potentially minor impacts in the coal spill study area, and that these impacts were restricted to a localized area (Borealis Environmental Consulting 2015).

**Operations—Indirect Impacts**

Operation of the proposed export terminal at the On-Site Alternative location would result in the following indirect impacts.

**Fish Stranding from Vessel Wakes**

At full build-out, 70 cargo vessels per month (840 per year) would be loaded at the terminal. The vessels would consist of the newer Panamax and Handymax vessels. Panamax vessels measure approximately 738 feet long by 105 feet wide with a draft of 43 feet. Handymax vessels measure approximately 490 to 655 feet long by 105 feet wide with a draft of 36 feet.

Subyearling Chinook salmon appear to be more susceptible to stranding, accounting for approximately 80% of the fish stranded by vessel wakes along the lower Columbia River (Hinton and Emmett 1994; Dawley et al. 1984; Pearson et al. 2006) despite being less common (i.e., 49%) in beach seine samples along the same shorelines (Pearson et al. 2006).

Studies indicate that juvenile salmon and other fish are at risk of stranding on wide, gently sloping (i.e., less than 5% slope) beaches as a consequence of wakes generated by deep-draft vessel passage (Bauersfeld 1977; Hinton and Emmett 1994; Pearson et al. 2006; ENTRIX 2008). Depending on various factors—such as the slope and breadth of a beach, river stage, tidal stage, depth of water vessel is transiting in, and vessel size—direction of travel and speed, wakes from passing vessels can travel a considerable distance. When these wakes meet the shoreline, they
can carry fish and deposit them, essentially stranding them on the beach where they are susceptible to stress, suffocation, and predation before than can return to the water.

The On-Site Alternative would result in an increase in vessel traffic, which characteristically produces wakes that would contribute to stranding, and many of the sites in the study area where fish stranding could occur are near the project area. For example, Lord Island is just across the navigation channel from the project area, and Barlow Point is about 1.2 miles downriver. Vessels maneuvering near the project area would be either slowing to stage nearby if the docks are full or slowing to prepare for docking. Once vessels are loaded, they would maneuver back to the navigation channel and then proceed downriver toward the Pacific Ocean. It is assumed such maneuvering would result in little risk of stranding near the proposed docks, as very little wake would be generated by vessels moving at slow speeds. Sites farther downriver, such as near Puget Island, would be more likely to have a higher risk of fish stranding from vessel wakes because vessels are transiting those areas at higher speeds.

Fish stranding in the lower Columbia River appears to be associated with various factors, but is generally believed to be an issue when wakes produced by deep-draft vessels (i.e., those with a draft of 26 feet or more) transiting the river during low tides encounter shorelines with shallow sloping beaches (i.e., less than a 5% slope). The issue is particularly prevalent on beaches that are highly permeable (i.e., high rates of infiltration due to unconsolidated substrate material). However, beaches are not necessarily conducive to stranding at all times. For example, stranding may occur less frequently or not at all during high tide or during periods when the river is at a certain stage, when the beaches are more inundated and less exposed. The potential for fish stranding on any given beach is also likely affected by fish migration changes through the area. In 2028, with full terminal throughput, the proposed terminal would represent approximately 27% of the projected vessel traffic volume in the lower Columbia River. The additional traffic associated with the terminal would increase the risk of fish stranding.

Vessel operations in the lower Columbia River are federally regulated, including the size, speed, and navigation within the river. Additionally, large vessels sailing the lower Columbia River are required to be operated by pilots licensed by the U.S. Coast Guard. The navigation channel is managed and regulated at the federal level, including maintenance dredging and dredged material disposal.

Physical or Behavioral Responses to Vessel Noise

Vessels transit the Columbia River carrying oil, freight, and materials to and from ports along the river. Mean source sound levels of bulk carrier vessels were calculated in Puget Sound at between 187.9 and 198.2 dB sound pressure level when vessels were travelling between 9.0 and 11.1 knots (Hemmera Envirochem et al. 2014). These source sound levels exceed identified thresholds for potential behavioral disturbance for fish and may cause avoidance or other behavioral responses (Fisheries Hydroacoustic Working Group 2008). Fish near transiting vessels could experience behavioral responses to the vessel noise but would not likely be injured.

Maintenance Dredging and Aquatic Habitat

Maintenance dredging would likely occur every few years, as needed, to maintain required depths at Docks 2 and 3 and to allow for navigation between the docks and the navigation channel (WorleyParsons 2012). Maintenance dredging would require separate permitting
outside those permits issued for construction of the On-Site Alternative. Maintenance dredging would follow the same methods and have the same impacts as those described for construction-related dredging.

**Coal Dust**

Coal dust would be generated during operation of the terminal through the movement of coal into and around the project area, as well as during transfer onto vessels (Chapter 6, Sections 6.6, *Air Quality*, and 6.7, *Coal Dust*). Coal dust could also become airborne from stockpiles located within the project area. Modeled fugitive coal dust concentrations (Figure 5.7-6) indicate that deposition would range from 1.45 grams per square meter per year (g/m²/year) adjacent to the terminal to 0.01 gram per square meter 2.41 miles from the terminal (Chapter 6, Section 6.7, *Coal Dust*). One review of the chemical composition of coal dust (U.S. Geological Survey 2007) suggests the risk of exposure to toxic materials (e.g., PAHs and trace metals) from coal are low because the concentrations in coal are low and the chemicals bound to coal and not easily leached. Particles would also be transported downriver by the flow of the river and distributed over a broad area, diluting any potential impacts.

**Commercial and Recreational Fishing**

Project-related increases in vessel traffic in the lower Columbia River and associated underwater noise could affect fishing in the study area. Increases in vessel traffic could cause behavioral responses including quicker migration or avoidance of the navigation channel. An average of 70 large commercial vessels would be loaded at the terminal each month. If adult fish targeted in commercial and recreational fishing were to alter behavior in response to increased underwater noise, they may avoid or migrate quickly through the navigation channel. It is also likely that commercial and recreational fishing vessels would not be fishing within the navigation channel when large vessels are present. Therefore, the On-Site Alternative likely would not significantly reduce commercial or recreational fishing catches or limit access for fishing activities. See Chapter 6, Section 6.4, *Vessel Transportation*, for potential impacts on commercial and recreational fishing vessels associated with project-related vessels.
Figure 5.7-6. 3-Year Annual Average Coal Dust Deposition for the Proposed Action
5.7.5.2 Off-Site Alternative

This section describes the potential impacts that could occur in the study area as a result of construction and operation of the terminal at the Off-Site Alternative location. Impacts would be similar to those described in Section 5.7.2.1, On-Site Alternative, with minor differences.

Construction—Direct Impacts

Construction of the proposed export terminal at the Off-Site Alternative location would result in the following direct impacts.

Aquatic Habitat

Habitat in the Columbia River would be permanently removed by the placement of piles. A total of 597 36-inch-diameter steel piles would be placed in the Columbia River, permanently removing 0.10 acre (4,220 square feet) of benthic habitat. Benthic organisms within the footprint of individual piles at the time of pile-driving would likely perish.

Dredging would permanently alter a 15-acre area of deep water habitat by removing approximately 50,000 cubic yards of benthic sediment to achieve the necessary depth, with a 2-foot overdredge allowance (Grette 2014e). As with the On-Site Alternative, dredged materials would likely be disposed of within the flow lane, in or adjacent to the Columbia River navigation channel between river miles 60 and 66, allowing these sediments to support the downriver sediment transport system (Grette 2014d, 2014e, 2014f). The overall impacts of dredging activities on fish would be the same as or similar to those described previously for the On-Site Alternative.

Overall impacts from pile installation are expected to be similar to those described for the On-Site Alternative. The Off-Site Alternative would require fewer piles (597 compared to 610) below the OHWM and the area of benthic habitat permanently lost would be less (4,220 square feet compared to 4,312). The Off-Site Alternative would involve dredging a smaller area (15 acres compared to 48 acres) and a smaller volume of material (50,000 cubic yards compared to 500,000 cubic yards). Under the Off-Site alternative no creosote piles would be removed because no timber pile dikes exist in the project area; therefore, no potential adverse impacts or benefits related to creosote piles would occur.

Physical or Behavioral Response from Elevated Turbidity

Potential impacts on fish resulting from elevated turbidity from pile-driving and dredged material disposal would be the same as or similar to those described for the On-Site Alternative. However, the Off-Site Alternative would require driving 597 piles below the OHWM, 13 fewer than the On-Site Alternative. The difference in terms of turbidity from driving 13 fewer piles would be negligible.

Physical or Behavioral Response to Underwater Noise

Potential impacts on fish resulting from underwater construction noise would be very similar to those described for the On-Site Alternative because of the small difference (597 compared to 610) in the number of piles driven.
Temporary Shading

Potential impacts on fish resulting from shading would be very similar to those described for the On-Site Alternative. The surface area of the docks and trestle for the Off-Site Alternative would be 0.01 acre less than the On-Site Alternative (4.82 compared to 4.83), and the overall area shaded would decrease slightly. The shading created by the vessels would be the same (4.7 acres for two Panamax vessels) for both alternatives.

Spills and Leaks

Potential impacts on fish resulting from construction-related spills and leaks would be the same as or similar to those described for the On-Site Alternative.

Construction—Indirect Impacts

Construction of the proposed export terminal at the Off-Site Alternative would not result in indirect impacts on fish because no construction impacts would occur later in time or outside of the direct impacts study area.

Operations—Direct Impacts

Direct operational impacts of the Off-Site Alternative would result in impacts very similar to those described for the On-Site Alternative.

Operations—Indirect Impacts

Indirect operational impacts of the Off-Site Alternative would result in impacts very similar to those described for the On-Site Alternative. However, modeled fugitive coal dust concentrations for the Off-Site Alternative (Figure 5.7-7) indicate that deposition rates would range from 1.83 grams per square meter per year (g/m²/year) adjacent to the proposed export terminal to 0.01 g/m²/year approximately 2.98 miles from the terminal (Chapter 6, Section 6.7, Coal Dust), compared to the On-Site Alternative, which ranges from 1.45 g/m²/year adjacent to the terminal to 0.01 g/m²/year 2.41 miles from the terminal.

5.7.5.3 No-Action Alternative

Under the No-Action Alternative, the Corps would not issue a Department of the Army permit authorizing construction and operation of the proposed export terminal. As a result, impacts resulting from constructing and operating the terminal would not occur. In addition, not constructing the terminal would likely lead to expansion of the adjacent bulk product business onto the export terminal project area. Potential impacts on fish could occur under the No-Action Alternative similar to what is described for the On-Site Alternative, but the magnitude of the impact would depend on the nature and extent of the future expansion.
Figure 5.7-7. 3-Year Annual Average Coal Dust Deposition for the Off-Site Alternative
5.7.6 Required Permits

The following required permits are expected to reduce impacts on fish and fish habitat.

- **Shoreline Substantial Development and Conditional Use Permits—Cowlitz County.** Cowlitz County administers the Shoreline Management Act through its Shoreline Management Master Program. The project area would have elements and impacts within jurisdiction of the act (Cowlitz County Code [CCC] 19.20) and would, thus, require a Shoreline Substantial Development and Conditional Use permit from Cowlitz County and Ecology.

- **Critical Areas Permits—Cowlitz County.** Either Alternative would require local permits related to impacts on regulated critical areas. CCC 19.15 regulates activities within and adjacent to critical areas and in so doing regulates fish and wildlife habitat conservation areas (including streams and their buffers), frequently flooded areas, and other sensitive areas.

- **Construction and Development Permits—Cowlitz County.** Both Alternatives would require fill and grade permits (CCC 16.35) and construction permits (CCC 16.05) for clearing and grading and other ground disturbing activities, as well as construction of structures and facilities associated with the On-Site Alternative.

- **Clean Water Act Authorization—U.S. Army Corps of Engineers.** Construction and operation of the terminal would involve discharges of dredged and fill material waters of the United States, including wetlands. Department of the Army authorization from the U.S. Army Corps of Engineers would be required under Section 404 of the Clean Water Act. An Individual Water Quality Certification from Ecology under Section 401 of the Clean Water Act and a National Pollutant Discharge Elimination System (NPDES) permit under Section 402 of the Clean Water Act would also be required. Additional details regarding the permitting process related to the Clean Water Act can be found in the NEPA Water Quality Technical Report.

- **Rivers and Harbors Act—U.S. Army Corps of Engineers.** Construction and operation of the terminal would take place in navigable waters of the United States (i.e., the Columbia River). The Rivers and Harbors Act authorizes the Corps to protect commerce in navigable streams and waterways of the United States by regulating various activities in such waters. Section 10 of the Rivers and Harbors Act (33 USC 403) specifically regulates construction, excavation, or deposition of materials into, over, or under navigable waters, or any work that would affect the course, location, condition, or capacity of those waters.

- **Hydraulic Project Approval—Washington Department of Fish and Wildlife.** Both alternatives would require a Hydraulic Project Approval from WDFW because project elements would affect and cross the shoreline of the Columbia River. The approval would consider impacts on riparian and shoreline/bank vegetation in issuance and conditions of the permit, including for the installation of Docks 2 and 3 and piles, as well as for project-related dredging activities and other project-related in-water work.

- **Local Critical Areas and Construction Permits—City of Longview (Off-Site Alternative only).** The Off-Site Alternative would require permits from the City of Longview. Chapter 17.10 of the City of Longview Municipal Code (LMC) regulates activities within and adjacent to critical areas and in so doing regulates vegetation occurring in wetlands and their buffers, fish and wildlife habitat conservation areas (including streams and their buffers), frequently flooded
areas, and geological hazard areas. The City of Longview would require Critical Areas and Floodplain permits, as well as a building permit for clearing, grading, and construction.

- **Shoreline Substantial Development—City of Longview (Off-Site Alternative only).** The City of Longview administers the Shoreline Management Act through its Shoreline Management Master Program. The Off-Site Alternative project area would have elements and impacts within jurisdiction of the act and would, thus, require a Shoreline Substantial Development permit from the City of Longview.