# 3.3. FISH

## 3.3.1. Affected Environment

### 3.3.1.1. EXISTING CONDITIONS

Hood Canal is known to support at least 250 species of marine fish, including anadromous species (salmonids) that live part of their life cycle in fresh water (Schreiner et al. 1977; Miller and Borton 1980; Prinslow et al. 1980; Bax 1983; Salo 1991; Bhuthimethee et al. 2009; Burke Museum 2010). Common fish species known or expected to occur in Hood Canal are listed in Appendix A. Seven threatened or endangered marine fish species have the potential to occur in the waters of northern Hood Canal, and are discussed separately under the Threatened and Endangered Species section below (Section 3.3.1.3). Non-ESA-listed marine fish have been categorized into three groups (salmonids, forage fish, and other marine fish) to facilitate a discussion of similar species, and are discussed in Section 3.3.1.4. Non-ESA-listed salmonids include both naturally spawning and hatchery-released salmon and trout species. Forage fish are those species that are considered a vital food resource to salmonids and other fish predators, as discussed in Section 3.3.1.5. Other marine fish include all other species ranging from benthic dwelling (demersal) to shallow-water species. Other marine fish are discussed in Section 3.3.1.6.

Seven salmonid species occur within the marine waters of Hood Canal: Chinook salmon, chum salmon, coho salmon, pink salmon, steelhead, bull trout, and cutthroat trout. Five hatcheries augment salmon populations by releasing four of these species (Chinook, chum, coho, and pink salmon) into Hood Canal. In 2006, approximately 34 million hatchery salmonids were released in Hood Canal to support the multi-million-dollar sport, commercial, and tribal salmon fisheries in the region (SAIC 2006; Appendix B). These releases included approximately 25.1 million chum, 6.7 million Chinook, 1.6 million coho, and 467,000 pink salmon. Release dates varied from April 1 to June 1, depending on species and release location (SAIC 2006; Regional Mark Processing Center 2009). Since hatcheries were not required to mark 100 percent of all salmonids released, unmarked hatchery fish captured along the Bangor shoreline are indistinguishable from naturally spawned fish (SAIC 2006; Bhuthimethee et al. 2009). This is particularly problematic when estimating the distinction between seasonal occurrence and abundance of naturally spawned summer-run chum, naturally spawned fall-run chum, and hatchery-released chum salmon (SAIC 2006; Bhuthimethee et al. 2009; Appendix B).

Forage fish species present along the Bangor shoreline primarily include Pacific herring, surf smelt, and Pacific sand lance. In addition, over 45 other non-salmonid finfish species occur in the vicinity of the proposed project area (SAIC 2006; Bhuthimethee et al. 2009).

Marine fish species that are more prevalent in deeper offshore habitats include a variety of rockfish species, Pacific hake, walleye pollock, wolfeel, skates, sharks, lanternfish, snailfish, and flatfish species. Recent fish surveys in nearshore habitats along the Bangor shoreline have documented the occurrence of juvenile salmonids and forage fish, as well as a variety of other species, including perches, gunnels, pricklebacks, sculpins, pipefish, threespine sticklebacks, tubesnouts, and juvenile flatfish species (Bhuthimethee et al. 2009).

Fish habitat along the Bangor waterfront has been characterized as diverse and healthy based on analyses of fish species richness, composition, abundance, and size distribution; fish habitat includes marine waters, estuaries, and streams (URS 1994). Of particular importance are the freshwater outlets from Hunter's Marsh, Devil's Hole, and Cattail Lake that provide warmer, nutrient-rich fresh water in these areas. This warmer water supports dense marine vegetation and benthic communities, which provide refuge and food sources for marine fish, including juvenile salmon.

#### 3.3.1.2. ESSENTIAL FISH HABITAT

The MSA (16 USC 1801-1881 et seq.), through the Essential Fish Habitat (EFH) provision, protects waters and substrate necessary for federally managed (commercially harvested) fisheries in Washington waters. Federal agencies are required to consult with NMFS about activities that may adversely affect EFH for species protected under the MSA. The MSA is currently undergoing reauthorization and is expected to be reauthorized by the time of project construction. The analysis of EFH in this EIS is based on the provisions of the current MSA.

In addition to the federal agencies that regulate threatened and endangered fish species, the Point No Point Treaty Tribes (PNPTT) are co-managers with WDFW in regulating harvest management and supplementation programs for the Hood Canal summer-run chum evolutionarily significant unit (ESU) (71 Federal Register [FR] 47180). The PNPTT include the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes, who have treaty rights to Usual and Accustomed (U&A) fishing across the summer-run chum geographic range (71 FR 47180). Additional groups that contribute to and oversee recovery planning include the Puget Sound Technical Recovery Team (PSTRT) and the Hood Canal Coordinating Council (HCCC), respectively (71 FR 47182).

The PFMC has designated EFH for Pacific groundfish, coastal pelagic species, and Pacific salmon species (PFMC 2011, 2014a,b). The federally managed species, life stages, and habitats, as indicated by PFMC FMPs, are summarized for Hood Canal and the project vicinity (Table 3.3–1). Pacific groundfish EFH is designated for species and life stages and includes five primary habitats: the epipelagic zone of the water column (including macrophyte canopies and drift algae); unconsolidated sediments of mud and sand; hard-bottom habitats of boulders, bedrock, and coarse deposits; mixed sediments of sand and rocks; and vegetated bottoms with algal beds, macrophytes, or rooted vascular plants (PFMC 2014a, Appendix B4). The PFMC (2014a) has also designated EFH for each individual groundfish species by life stage. For those species that were covered in 2005, these designations are contained within the 2005 Appendix B4 of the FMP. The life history for each of the 2005-covered groundfish species was included in the 2005 Appendix B2 of the Pacific Coast Groundfish FMP (PFMC 2014a, Appendix B2). However, in May 2014 the Pacific Coast Groundfish FMP was updated to include a total of 89 species. Using the Pacific Habitat Use Relational Database developed by the PFMC, it was determined which groundfish species and life stages have EFH designated within the vicinity of the LWI and SPE project sites. Of the groundfish species described in the FMP, 33 were identified through the analysis of the Habitat Use Relational Database as having EFH designated in the vicinity of NAVBASE Kitsap Bangor (Table 3.3–1).

Coastal pelagic EFH consists of all marine and estuarine waters between the shoreline and the exclusive economic zone, above the thermocline and falling between 50 and 79°F (10 and 26°C) in temperature. The PFMC manages coastal pelagic species, two of which (anchovy and market squid) occur in Hood Canal and the vicinity of the project site.

Pacific salmon EFH includes all estuarine waters and substrates, including the nearshore and tidal submerged environments, and freshwater bodies historically accessible to salmon. The PFMC manages three salmonids that occur in Hood Canal: coho, Chinook, and pink salmon.

**Table 3.3–1. Fish Species with Designated EFH in Hood Canal**

| Species | Applicable Life Stages | Designated Habitats |
|---|---|---|
| **Groundfish** | | |
| Big skate | A,J,E | Unconsolidated bottom |
| Black rockfish | A,J | Artificial structure, hard bottom, vegetated bottom, epipelagic zone, tide pool |
| Blue rockfish | A,J,L | Hard bottom, vegetated bottom, epipelagic zone |
| Bocaccio | J,L | Hard bottom, epipelagic zone |
| Brown rockfish | A,J | Artificial structure, hard bottom, mixed bottom, vegetated bottom, epipelagic zone |
| Butter sole | A,J,L,E | Unconsolidated bottom, epipelagic zone |
| Cabezon | A,J,L,E | Hard bottom, tide pool, unconsolidated bottom, vegetated bottom, epipelagic zone |
| China rockfish | A,J | Hard bottom, vegetated bottom, epipelagic zone |
| Copper rockfish | A,J | Artificial structure, hard bottom, mixed bottom, vegetated bottom, epipelagic zone |
| English sole | A,J,E | Unconsolidated bottom, epipelagic zone |
| Flathead sole | A,J | Unconsolidated bottom |
| Kelp greenling | A,J,L,E | Hard bottom, vegetated bottom, epipelagic zone |
| Lingcod | A,J,L,E | Hard bottom, vegetated bottom, unconsolidated bottom, epipelagic zone |
| Longnose skate | A | Unconsolidated bottom |
| Pacific sanddab | A,J,L,E | Mixed bottom, unconsolidated, epipelagic zone |
| Pacific whiting (hake) | A,J | Epipelagic zone |
| Petrale sole | A,J,L,E | Unconsolidated bottom |
| Quillback rockfish | A,J,L | Artificial structure, mixed bottom, vegetated bottom, hard bottom, biogenic, epipelagic zone |
| Redstripe rockfish | A,J,L | Hard bottom, mixed bottom, epipelagic zone |
| Rex sole | A,J | Unconsolidated bottom |
| Rock sole | A,J,L,E | Unconsolidated bottom, mixed bottom, epipelagic zone |
| Sablefish | A,J,L,E | Unconsolidated bottom, epipelagic zone |

**Table 3.3–1. Fish Species with Designated EFH in Puget Sound (continued)**

| Species | Applicable Life Stages | Designated Habitats |
|---|---|---|
| Sand sole | A,J,L | Unconsolidated bottom, epipelagic zone |
| Silvergray rockfish | A | Hard bottom |
| Soupfin shark | A,J | Unconsolidated bottom, epipelagic zone |
| Spiny dogfish | A,J | Unconsolidated bottom, epipelagic zone |
| Splitnose rockfish | J,L | Epipelagic zone |
| Spotted ratfish | A,J,E | Hard bottom, unconsolidated bottom |
| Starry flounder | A,J,L,E | Unconsolidated bottom, epipelagic zone |
| Tiger rockfish | A,J,L | Hard bottom, epipelagic zone |
| Widow rockfish | A,J,L | Hard bottom, mixed bottom, epipelagic zone, unconsolidated bottom, vegetated bottom |
| Yelloweye rockfish | A,J,L | Hard bottom, mixed bottom, epipelagic zone, biogenic |
| Yellowtail rockfish | A,J | Hard bottom, unconsolidated bottom, vegetated bottom, epipelagic zone |
| **Coastal Pelagic Species** | | |
| Anchovy | A,L,E | All estuarine waters above the thermocline and falling between 10 and 26°C |
| Market squid | A,L,E | Same as above |
| **Salmon** | | |
| Coho | A,J | All estuarine waters and substrates, including the nearshore and tidal submerged environments, and freshwater bodies historically accessible to salmon |
| Chinook | A,J | Same as above |
| Pink | A,J | Same as above |

Sources: PFMC 2011, 2014a,b.
A = adult; E = eggs; J = juvenile; L = larvae.

#### 3.3.1.3. THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

This section summarizes species-specific life history and occurrence information, with additional details provided in Appendix B, on ESA-listed salmonids and rockfish. The summary of marine habitat conditions, described in Section 3.3.1.7, is applicable to both ESA-listed and non-listed species of marine fish. Table 3.3–2 provides the federal ESA listing for marine fish and whether critical habitat is designated near the Bangor waterfront.

##### 3.3.1.3.1. PUGET SOUND CHINOOK

The Puget Sound Chinook salmon ESU was listed as federally threatened under the ESA in 1999 (64 FR 14308), with the threatened listing reaffirmed in 2005 (70 FR 37160). Critical habitat was designated for Puget Sound Chinook in 2005 (70 FR 52685) and the recovery plan and supplement to the recovery plan were published in 2007 (NMFS 2006; Shared Strategy for Puget Sound 2007). Chinook are the largest species of salmonid. In general, juveniles out-migrate as

**Table 3.3–2. Federally Listed Threatened and Endangered Marine Fish in Hood Canal**

| Fish | Federal Listing | Critical Habitat | Critical Habitat Designated in Northern Hood Canal |
|---|---|---|---|
| **Puget Sound Chinook** | Threatened<br>*70 FR 37160, June 28, 2005* | Designated<br>Depth -33 feet (-30 meters)<br>*70 FR 52630, September 2, 2005* | Designated along the shoreline to depth of -33 feet (-30 meters) except not along Bangor waterfront. |
| **Hood Canal summer-run chum** | Threatened<br>*64 FR 14508, March 25, 1999* | Designated<br>Depth -33 feet (-30 meters)<br>*70 FR 52630, September 2, 2005* | Designated along the shoreline to depth of -33 feet (-30 meters) except not along Bangor waterfront. |
| **Puget Sound steelhead** | Threatened<br>*72 FR 26722, May 11, 2007* | Designated<br>*81 FR 9251, February 24, 2016* | Occupied riverine habitats in the Hood Canal Subbasin. |
| **Bull trout** | Threatened<br>*64 FR 58910, November 1, 1999* | Designated<br>Depth -33 feet (-10 meters)<br><br>*75 FR 63898 October 18, 2010*<br>Effective<br>*November 17, 2010* | Designated along the shoreline to depth of -33 feet (-10 meters). The closest critical habitat occurs along the western and northern shores of Dabob Bay beyond Hazel Point, at the southern tip of Toandos Peninsula, which is outside of the area affected by the proposed action. |
| **Bocaccio** | Endangered<br>*75 FR 22276, April 28, 2010* | Designated<br>*79 FR 68041, Primary constituent elements (PCEs) November 13, 2014, Effective February 11, 2015* | Nearshore and deepwater habitats of Hood Canal, excluding DoD boundaries. |
| **Canary rockfish** | Threatened<br>*75 FR 22276, April 28, 2010* | Designated<br>*79 FR 68041, PCEs November 13, 2014, Effective February 11, 2015* | Nearshore and deepwater habitats of Hood Canal, excluding DoD boundaries. |
| **Yelloweye rockfish** | Threatened<br>*75 FR 22276, April 28, 2010* | Designated<br>*79 FR 68041, PCEs November 13, 2014, Effective February 11, 2015* | Nearshore and deepwater habitats of Hood Canal, excluding DoD boundaries. |

DoD = Department of Defense; FR = Federal Register sub-yearlings or yearlings and return to spawn as adults, generally after 3 to 5 years. Chinook salmon are one of the least abundant salmonids occurring along the Bangor shoreline (Appendix B, Figure B–1). From 2005 to 2008 a total of 58,667 salmonids were captured in beach seine surveys along the NAVBASE Kitsap Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). During that time period, only 224 of the total number of salmonids captured (approximately 0.4 percent) were juvenile Chinook salmon (Appendix B, Figure B–1). As suggested by findings of Chamberlin et al. (2011), juvenile Chinook salmon may have extended intra-basin residence times, and may not necessarily utilize nearshore habitats solely as a nearshore migratory corridor during out-migration. Additional details describing the life history of Puget Sound Chinook are also provided in Appendix B.

CRITICAL HABITAT DESCRIPTION

A final designation of Puget Sound Chinook salmon critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (70 FR 52685). Nearshore marine waters within Hood Canal were included as part of this designation. Although critical habitat occurs in northern Hood Canal waters adjacent to the base (Figure 3.3-1), NAVBASE Kitsap Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon by federal law (70 FR 52630; 81 FR 7226). No Puget Sound Chinook salmon critical habitat is located in the immediate vicinity of the LWI or SPE project sites. The closest critical habitat is located immediately beyond the northern and southern base boundaries.

*OCCURRENCE AT LWI PROJECT SITES*

Appendix B provides detailed information regarding the in-migration and spawn timing of adult Puget Sound Chinook past NAVBASE Kitsap Bangor and within the greater Hood Canal region. In general, adult Chinook salmon enter Hood Canal waters from August to October and begin spawning in their natal streams in September, with peak spawning occurring in October. Juvenile Puget Sound Chinook peak out-migration along the Bangor shoreline, and within the greater Hood Canal region, generally occurs from May to early July. As described further in Appendix B, Chinook salmon are one of the least abundant salmonids occurring along the Bangor shoreline, with occurrence in survey data so low that determining a prevalence at one location over another was not possible (SAIC 2006; Bhuthimethee et al. 2009).

*OCCURRENCE AT SPE PROJECT SITES*

Due to the close proximity, adult and juvenile Chinook at the SPE site would be comparable to those occurrences at the LWI project sites.

3.3.1.3.2. HOOD CANAL SUMMER-RUN CHUM SALMON

The Hood Canal summer-run chum salmon ESU was federally listed as threatened under the ESA in 1999, and the threatened listing was reaffirmed in 2005 (70 FR 37160) (Table 3.3–2). Critical habitat was also designated for Hood Canal summer-run chum ESU in 2005, and the NMFS recovery plan for this species was adopted on May 24, 2007 (72 FR 29121). The Hood Canal summer-run chum ESU includes all naturally spawned populations and supplemented stocks of summer-run chum salmon in Hood Canal and its tributaries. Reduced viability, lower survival, and listing of extant stocks of summer-run chum and recent stock extinctions in Hood Canal are

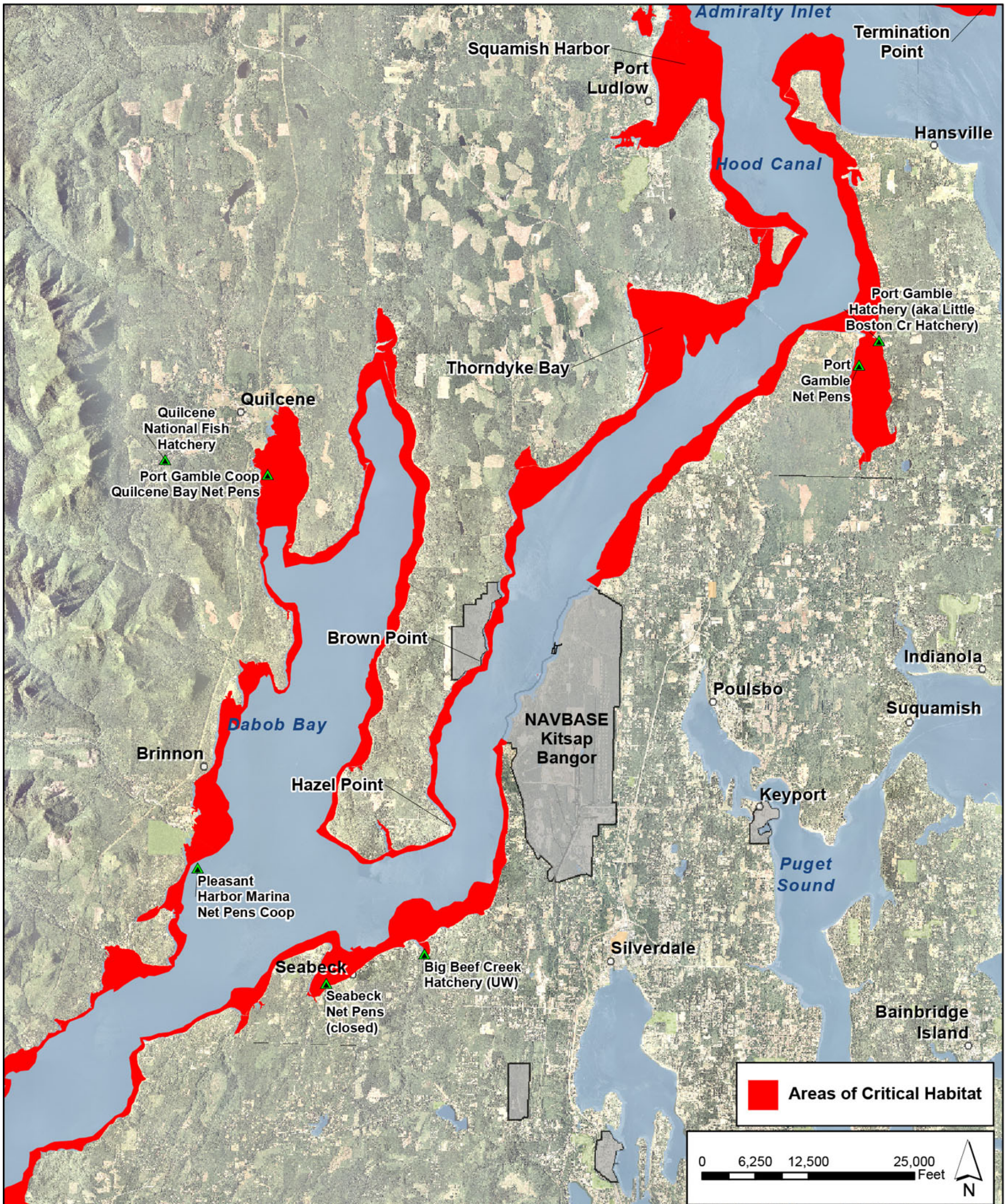



**Figure 3.3–1. Puget Sound Chinook and Hood Canal Summer-Run Chum Salmon Critical Habitat for Hood Canal Nearshore Marine Areas**

attributed to the combined impacts of three primary factors: (1) habitat loss and degradation, (2) climate change, and (3) increased fishery harvest rates (HCCC 2005). An additional factor cited in WDFW and PNPTT (2000) and HCCC (2005) was impacts associated with the releases of hatchery salmonids, which compete with naturally spawning stocks for food and other resources. Additional details describing the life history of Hood Canal summer-run chum salmon are provided in Appendix B.

CRITICAL HABITAT DESCRIPTION

A final designation of Hood Canal summer-run chum salmon critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (70 FR 52685). Nearshore marine waters within Hood Canal were included as part of this designation. Although critical habitat occurs in northern Hood Canal waters adjacent to the base (Figure 3.3–1), NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation for ESA-listed Hood Canal summer-run chum salmon. No Hood Canal summer-run chum salmon critical habitat is located in the immediate vicinity of the LWI or SPE project sites. The closest critical habitat is immediately beyond the northern and southern base boundaries.

*OCCURRENCE AT LWI PROJECT SITES*

Appendix B provides detailed information regarding the in-migration and spawn timing of adult Hood Canal summer-run chum salmon and out-migration of juveniles past NAVBASE Kitsap Bangor, and within the greater Hood Canal region. Juvenile chum salmon were much more abundant than any other salmonid species captured along the Bangor shoreline (SAIC 2006; Bhuthimethee et al. 2009; Appendix B, Figure B–1). From 2005 to 2008 a total of 58,667 salmonids were captured in beach seine surveys along the NAVBASE Kitsap Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). During that time 55,554 of the total number of salmonids captured (approximately 94.7 percent) were juvenile chum salmon (Appendix B, Figure B–1). Young-of-the-year chum salmon migrate almost immediately after hatching in their natal streams, occurring along the NAVBASE Kitsap Bangor shoreline as early as January and as late as June (SAIC 2006; Bhuthimethee et al. 2009). Later releases by hatcheries in Hood Canal south of the base generally occur in April and May (SAIC 2006; Bhuthimethee et al. 2009). Summer-run chum adults return to Hood Canal from as early as August and September through the first week in October (Washington Department of Fisheries et al. 1993; WDFW and PNPTT 2000).

*OCCURRENCE AT SPE PROJECT SITES*

Due to the close proximity of the SPE project site to the south LWI project site, the occurrence of adult and juvenile summer-run chum salmon at the SPE project site would be comparable to occurrences at the south LWI project site.

3.3.1.3.3. PUGET SOUND STEELHEAD

The Puget Sound steelhead was listed in May 2007 under the ESA as a threatened distinct population segment (72 FR 26722). A distinct population segment (DPS) is a term used under the ESA to define a population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. Stocks of the Puget Sound steelhead DPS are mainly winter-run, although a few small stocks of summer-run steelhead also occur (71 FR

15666). As indicated by NMFS (2011) the principal factor for decline for Puget Sound steelhead is the present or threatened destruction, modification, or curtailment of its habitat or range. Within the proposed project area these threats may include barriers to fish passage, adverse effects on water quality, loss of wetland and riparian habitats, and other urban development activities contributing to the loss and degradation of steelhead habitats in Hood Canal. Additional details describing the life history of Puget Sound steelhead are provided in Appendix B.

CRITICAL HABITAT DESCRIPTION

Puget Sound steelhead critical habitat was proposed in January 2013 (78 FR 2725) and designated in February 2016 (81 FR 9251). Within the Hood Canal Subbasin, currently occupied riverine habitat is proposed as Puget Sound steelhead critical habitat. NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation. No steelhead critical habitat is located in the immediate vicinity of the LWI or SPE project areas.

*OCCURRENCE AT LWI PROJECT SITES*

Steelhead would be expected to occur most frequently in the late spring and early summer months, but overall this species does not occur in large numbers along the Bangor shoreline (SAIC 2006; Bhuthimethee et al. 2009; Appendix B, Figure B–1). Numbers are insufficient to determine site preference along the Bangor shoreline (Appendix B). The majority of adult winter-run steelhead in Hood Canal (Skokomish, Hamma Hamma, Duckabush, Quilcene/Dabob Bay, and Dosewallips) spawn from mid-February to mid-June (WDFW 2002) (Appendix B). Information published to date indicates that adult winter-run steelhead spawning occurs from mid-February to early June. Spawn timing of summer-run steelhead in Hood Canal is not fully understood; however, spawning is believed to occur from February through April (WDFW 2002). From 2005 to 2008 a total of 58,667 salmonids were captured in beach seine surveys along the NAVBASE Kitsap Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). During that time period only 58 of the total number of salmonids captured (approximately 0.1 percent) were juvenile steelhead (Appendix B, Figure B–1). In the 2013 proposed critical habitat notification, studies reviewed by NMFS indicated that "steelhead migratory behavior strongly suggest that juveniles spend little time (a matter of hours in some cases) in estuarine and nearshore areas and do not favor migration along shorelines" (78 FR 2725).

*OCCURRENCE AT SPE PROJECT SITES*

Due to the close proximity of the SPE project site to the south LWI project site, the occurrence of adult and juvenile steelhead at the SPE project site would be comparable to occurrences at the south LWI project site.

3.3.1.3.4. BULL TROUT

Currently, all populations of bull trout in the lower 48 states are listed as threatened under the ESA. The recovery plan for the coterminous U.S. bull trout population was published in September 2015 (USFWS 2015). Bull trout are in the char subgroup of salmonids and have both resident and migratory life histories (64 FR 58910). The Coastal-Puget Sound bull trout DPS reportedly contains the only occurrence of anadromous bull trout in the contiguous United States (64 FR 58912); Hood Canal is one of five geographically distinct regions within this DPS.

However, in a recent biological opinion, the USFWS noted summaries of recent tagging studies that indicated bull trout in the South Fork Skokomish River are not anadromous, and Cushman Dam currently blocks all upstream access and most downstream access to the marine environment for bull trout in the North Fork of the Skokomish River (USFWS 2011). Historical observations of bull trout in accessible anadromous reaches of several west Hood Canal tributary rivers (Quilcene, Hamma Hamma, Dosewallips, and Duckabush) are noted from the 1980s (as reviewed by USFWS 2009). Spawning was not believed to occur in these rivers and bull trout were presumed to use Hood Canal marine waters as a migration corridor (USFWS 2009).

Neither historic nor more recent fish surveys at the NAVBASE Kitsap Bangor waterfront (using beach and lampara seines and tow nets) have captured bull trout (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009; WDFW 2015 unpublished data). Based on this information and the lack of documented anadromy from the Skokomish River core population, USFWS considered bull trout unlikely to migrate through the NAVBASE Kitsap Bangor waterfront from the Skokomish River (USFWS 2011).

CRITICAL HABITAT DESCRIPTION

Critical habitat was originally designated for bull trout in 2005 (70 FR 56212) with a final revision to this habitat published in 2010 (75 FR 63898). NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation. Although both the original and revised final bull trout critical habitat occur in Hood Canal, neither designates waters north of Hazel Point, at the southeastern tip of Toandos Peninsula (Figure 3.3–2). No bull trout critical habitat is located in the immediate vicinity of the LWI or SPE project areas.

*OCCURRENCE AT LWI AND SPE PROJECT SITES*

Bull trout in the Skokomish River system are thought to spawn from mid-September to December (WDFW 2004). For the species overall, emergence of fry occurs from early April to May (64 FR 58910). Not enough is known to fully describe the duration of juvenile out-migration specifically for bull trout in Hood Canal (WDFW 2004), although it is unlikely that bull trout migrate through the Bangor waterfront and past the LWI or SPE project site (USFWS 2010). Neither historic nor recent juvenile fish surveys (using beach and lampara seines and tow nets) have captured bull trout (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009).

##### 3.3.1.3.5. BOCACCIO

Puget Sound bocaccio, a species of rockfish, were federally listed as endangered under the ESA in 2010 (75 FR 22276) (Table 3.3–2). Although rockfish are typically long-lived, recruitment is generally poor as larval survival and settlement are dependent on a variety of factors including marine currents, adult abundance, habitat availability, and predator abundance (Palsson et al. 2009; Drake et al. 2010). The combination of these factors, and the threats described below, has contributed to declines in the species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516). The species is believed to have commonly occurred along steep walls in most of Puget Sound prior to fishery exploitations, although they are currently very rare in these habitats (Love et al. 2002). Information on habitat requirement for most rockfishes is limited


**Figure 3.3–2. Bull Trout Critical Habitat for Hood Canal Nearshore Marine Areas**

despite years of research. Even less is known about bocaccio in Puget Sound (Palsson et al. 2009; Drake et al. 2010). Appendix B provides more detailed information regarding the general life history of bocaccio, and their prevalence within Puget Sound.

Threats to rockfish in Puget Sound include areas of low DO, commercial and sport fisheries (notably mortality associated with fishery bycatch), reduction of kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including exotic species), derelict gear (e.g., lost or abandoned fishing nets), climate change, species interactions (including predation and competition), diseases, and genetic changes (Palsson et al. 2009; Drake et al. 2010).

CRITICAL HABITAT DESCRIPTION

Critical habitat for yelloweye rockfish, canary rockfish, and bocaccio of the Puget Sound Georgia Basin was designated in November 2014 (79 FR 68042). The NMFS summary description of rockfish critical habitat locations, boundaries, and essential features is provided in Section 3.3.1.8.1. NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation, while NMFS' designation of rockfish critical habitat (79 FR 68041) specifically exempts the Bangor Naval Restricted Areas (Figure 1–2). Therefore, no designated rockfish critical habitat occurs in the immediate vicinity of the LWI or SPE project areas.

*OCCURRENCE AT LWI AND SPE PROJECT SITES*

Palsson et al. (2009) noted bocaccio were only recorded 110 times in their review of historical Puget Sound studies, with most records being associated with sport catch from the 1970s in Tacoma Narrows and Appletree Cove (near Kingston). There are only two records of bocaccio in Hood Canal, both in the 1960s, and there were no confirmed observations of bocaccio in Puget Sound for the 7-year period leading up to 2009 (74 FR 18516). A recent survey by WDFW detected only one bocaccio in the main basin of Puget Sound (Frierson et al. 2015, personal communication).

The most recent review of rockfish occurrence in Puget Sound included several citations for historical occurrences in Hood Canal (NMFS 2014a). WDFW is currently conducting rockfish surveys within Hood Canal, however preliminary results have not identified ESA-listed species (Frierson et al. 2015, personal communication). Therefore, bocaccio rockfish have the potential to occur within waters adjacent to the NAVBASE Kitsap Bangor waterfront, but they are anticipated to be extremely rare.

#### 3.3.1.3.6. CANARY ROCKFISH

Puget Sound canary rockfish were federally listed as threatened under the ESA in 2010 (75 FR 22276) (Table 3.3–2). Similar to bocaccio, adult canary rockfish are considered associated with high-relief, rocky habitats, and larval and juvenile stages likely utilize open water and nearshore habitats. Appendix B provides more detailed information regarding the general life history of canary rockfish and their prevalence within Puget Sound. The same stressors contributing to the decline of bocaccio, described above, also affect canary rockfish (74 FR 18516; Palsson et al. 2009; Drake et al. 2010).

CRITICAL HABITAT DESCRIPTION

Critical habitat has been designated for the three ESA-listed rockfish species. Additional information is provided in Section 3.3.1.8.1.

*OCCURRENCE AT LWI AND SPE PROJECT SITES*

Palsson et al. (2009) noted 114 records of canary rockfish in Puget Sound prior to the mid-1970s, with most records attributed to sport catch from the 1960s to 1970s in Tacoma Narrows, Hood Canal, San Juan Islands, Bellingham, and Appletree Cove. Within Hood Canal, 14 records occurred: 1 in the 1930s and at least 13 in the 1960s (Miller and Borton 1980). However, a more recent review by NMFS noted multiple occurrences of canary rockfish in Hood Canal (NMFS 2014a). In the final critical habitat ruling for rockfish, NMFS cited WDFW unpublished data documenting canary rockfish at several locations in Hood Canal, but they have been caught in relatively low numbers for the past several years (79 FR 68042 and also see NMFS 2014a).

WDFW is conducting rockfish surveys within Hood Canal; however, preliminary results have not identified ESA-listed species (Frierson et al. 2015, personal communication). Therefore, canary rockfish have the potential to occur within waters adjacent to the NAVBASE Kitsap Bangor waterfront, but their occurrence would be expected to be rare.

3.3.1.3.7. YELLOWEYE ROCKFISH

Puget Sound yelloweye rockfish were federally listed as threatened under the ESA in 2010 (75 FR 22276) (Table 3.3–2). The same stressors contributing to the decline of bocaccio affect yelloweye rockfish in a similar manner (74 FR 18516; Palsson et al. 2009; Drake et al. 2010). Recent reviews of Puget Sound rockfish species and their habitats (Palsson et al. 2009; Bargmann et al. 2010; Drake et al. 2010) suggest little distinction between these rockfish species in terms of habitat use in Puget Sound. Therefore, consistent with the discussion in Appendix B for bocaccio, adult yelloweye rockfish are considered associated with deeper, high-relief, rocky habitats, and larval and juvenile stages may utilize open water and nearshore habitats. The same stressors contributing to the decline of bocaccio also affect yelloweye rockfish (74 FR 18516; Palsson et al. 2009; Drake et al. 2010).

CRITICAL HABITAT DESCRIPTION

Critical habitat has been designated for the three ESA-listed rockfish species. Additional information is provided in Section 3.3.1.8.1.

*OCCURRENCE AT LWI AND SPE PROJECT SITES*

Palsson et al. (2009) noted 113 documented Puget Sound yelloweye rockfish historical records associated with sport catch. Of these records, 14 occurred in Hood Canal waters: 1 in the 1930s and 13 in the 1960s (Miller and Borton 1980). In the final critical habitat ruling for rockfish, NMFS cited WDFW unpublished data that documented canary rockfish at several locations in Hood Canal, although they have been caught in relatively low numbers for the past several years (79 FR 68042 and also see NMFS 2014a).

Currently WDFW is conducting rockfish surveys within Hood Canal. Although several yelloweye were caught in other areas of Hood Canal (Frierson et al. 2015, personal communication), preliminary results have not identified ESA-listed species within waters adjacent to the NAVBASE Kitsap Bangor waterfront. Therefore, their occurrence would be expected to be rare.

#### 3.3.1.4. NON-ESA-LISTED SALMONIDS

Non-ESA-listed anadromous salmonids that occur along the Bangor shoreline include hatchery and naturally produced fall-run chum salmon, coho salmon, pink salmon, sockeye salmon, and cutthroat trout. The different life history strategies of these species vary considerably, with different ages and timing for both in-migrating pre-spawn adults and out-migrating juveniles. Additional life history descriptions of non-ESA-listed salmonids are provided in Appendix B.

##### OCCURRENCE AT LWI AND SPE PROJECT SITES

Chum salmon (all runs combined) is the most abundant salmonid that occurs along the Bangor shoreline, accounting for approximately 94.7 percent of the salmonid catch during the 2005 through 2008 surveys (SAIC 2006; Bhuthimethee et al. 2009). Chum salmon are also the most abundant hatchery fish reared in Hood Canal (SAIC 2006; Bhuthimethee et al. 2009). As with pink salmon, chum salmon released from hatcheries are not marked (fin clipped). Thus, hatchery chum captured in Hood Canal surveys are indistinguishable in the field from naturally spawned chum (SAIC 2006; Bhuthimethee et al. 2009). Sockeye are the least abundant of these salmonids, as no sustainable runs occur within Hood Canal. Appendix B provides more detailed information regarding the migration timing and life history descriptions of non-ESA-listed salmonids with the potential to occur along the Bangor shoreline.

With respect to out-migrating juveniles, chum salmon and pink salmon migrate almost immediately after hatching in their natal streams, occurring along the Bangor shoreline as early as January and as late as June. These smaller, earlier migrating fish rely on nearshore habitats for food and refuge as they migrate within intertidal and shallow subtidal migratory pathways. Release of hatchery salmonids in Hood Canal south of the base, potential competitors for resources with naturally spawned, ESA-listed salmonids, generally occur in April and May (SAIC 2006; Bhuthimethee et al. 2009).

Other salmonids, such as Chinook, steelhead, and coho, can out-migrate as much larger yearlings or older, and tend to occur later in the spring and summer while also being released from hatcheries in April, May, and June. These larger fish are not as dependent on nearshore habitats for food and refuge, and occur in slightly deeper, offshore habitats. While they are not consistently abundant along the Bangor shoreline, coho occur in large schools for a limited time immediately following a hatchery release.

#### 3.3.1.5. FORAGE FISH

Nearshore habitat requirements for forage fish are similar to those for salmonids with respect to water and sediment quality, physical and biological habitat use, and underwater noise. One notable difference is that forage fish species use some areas of Puget Sound shorelines for spawning habitat, whereas salmonids use freshwater systems for spawning. Suitable spawning habitat for forage fish is species-specific, as discussed below for each species.

#### 3.3.1.5.1. Pacific Herring

Pacific herring are considered an important food resource for a variety of species in Puget Sound waters (Bargmann 1998). Therefore the condition of herring stocks, and other forage fish, can have broader marine community effects. The majority of herring spawning in Washington State waters occurs annually from late January through early April (Bargmann 1998). Pacific herring in Puget Sound typically return to natal holding and spawning areas (Bargmann 1998; Stick and Lindquist 2009). Typically, each stock has a pre-spawner holding area where ripening adult herring mill for three to four weeks prior to spawning. Herring spawn by depositing eggs on vegetation or other shallow-water substrate. Spawning generally occurs in the shallow subtidal zone, with eggs being deposited on vegetation or other shallow subtidal substrate (Bargmann 1998). Large holding spawning areas are found with patchy distribution in northern Hood Canal (Stick and Lindquist 2009); the closest to the project locations is found in Squamish Harbor, just under 7 miles (11 kilometers) to the north (Figure 3.3–3). Appendix B provides additional life history information regarding Pacific herring along the Bangor shoreline.

##### OCCURRENCE AT LWI PROJECT SITES

Appendix B provides additional detail on the life history and occurrence of Pacific herring along the shorelines of NAVBASE Kitsap Bangor. Pacific herring have been detected in small numbers during late winter months and large numbers in early summer months during recent surveys along the Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). Large herring spawning areas are found with patchy distribution in northern Hood Canal (Stick and Lindquist 2009).

With respect to differences in occurrence at the LWI project sites, Bhuthimethee et al. (2009) concluded that herring collected along the Bangor shoreline likely were indicative of a large school migrating along the shoreline, rather than indicating site-specific preference by that school. Study findings also indicated that Pacific herring occurring in late spring and summer are found in distinct schools, insufficient in size to span across multiple sampling sites, and do not appear to be attracted to, reside for any extended period at, or show preference toward any specific location.

##### OCCURRENCE AT THE SPE PROJECT SITE

The inconsistent capture of Pacific herring at the SPE project site was similar to that described above for the two LWI project sites. As discussed for the LWI sites, the capture of herring along the Bangor shoreline likely reflects the presence of large schools of fish on a few occasions and probably does not indicate any preference for the SPE project site. Appendix B provides additional detail on the occurrence of Pacific herring along the shorelines of NAVBASE Kitsap Bangor.

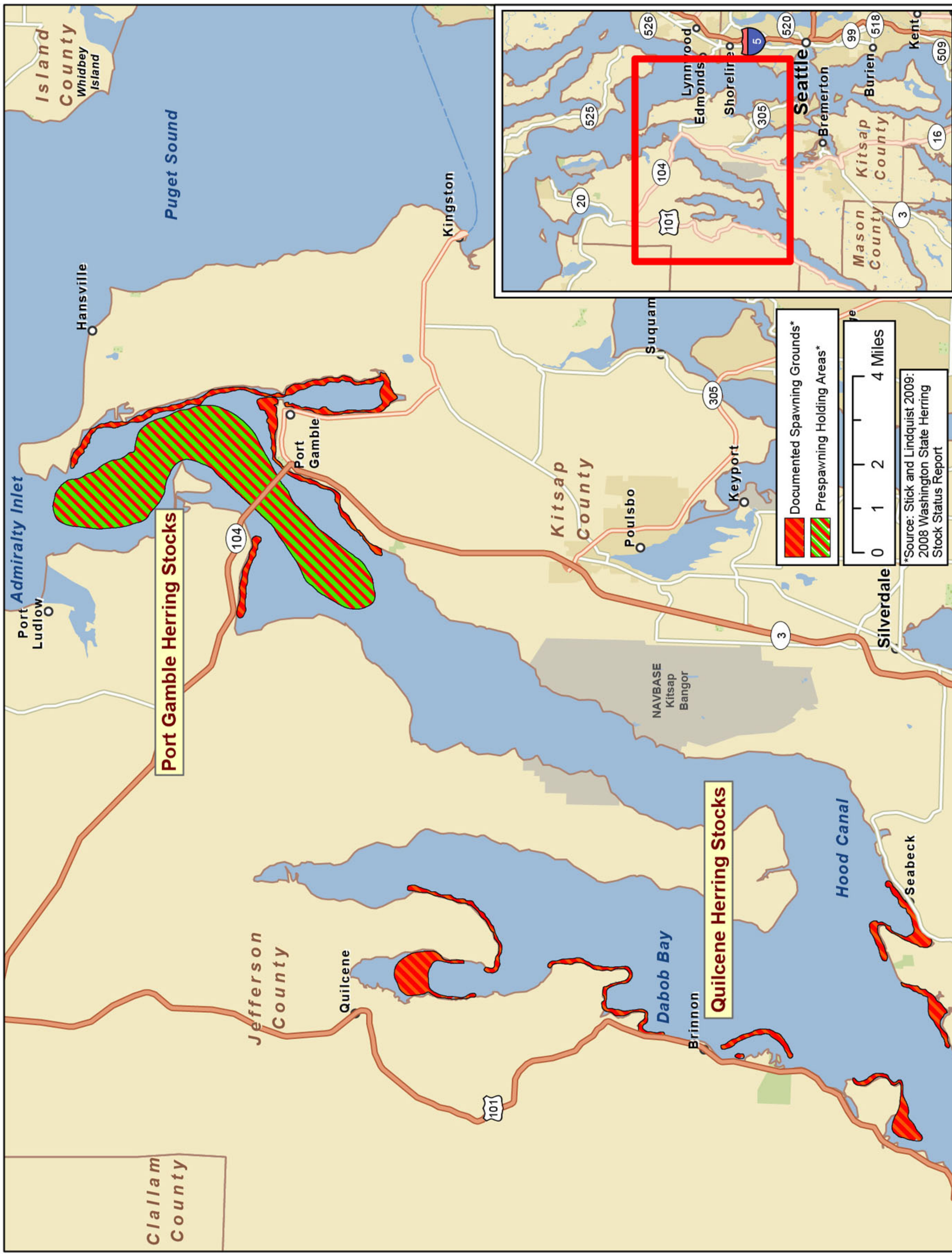



Figure 3.3–3. Port Gamble and Quilcene Bay Herring Stock Near NAVBASE Kitsap Bangor

#### 3.3.1.5.2. SURF SMELT

Similar to herring, surf smelt (*Hypomesus pretiosus*) are a small schooling fish that are an important food resource for marine bird, mammal, and fish species (Penttila 2007). Surf smelt life history in Puget Sound, other than spawning, is not well known, and there is no evidence of widespread migrations to and from the outer coast, although a number of stressors related to spawning habitat impacts have been summarized (Bargmann 1998; Penttila 2007; WDFW 2010a). Stressors limiting surf smelt reproduction include piles, bulkheads, and other shoreline armoring that can adversely affect nearshore littoral drift and sediment composition on, or adjacent to, surf smelt spawning beaches. Shoreline development may progressively eliminate or coarsen sediment composition in otherwise suitable surf smelt spawning substrate. In addition to sediment composition changes, surf smelt can be adversely affected by overall water, sediment, and habitat quality degradation, as well as changes in available invertebrate food resources. Appendix B provides additional detail on the life history and occurrence of surf smelt along the shorelines of NAVBASE Kitsap Bangor.

##### OCCURRENCE AT LWI PROJECT SITES

While periods of spawning and general spawning habitat conditions and locations are becoming more completely understood, much of the remaining aspects of surf smelt life history in Puget Sound is not well known. However, it is known that juvenile surf smelt rear in nearshore waters (Bargmann 1998). Although young-of-the-year surf smelt have been detected in the project area, no surf smelt spawning habitat has been documented along this portion of Hood Canal (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b). Field investigations were conducted in 2013 and 2014 at six NAVBASE Kitsap Bangor study locations (NAVFAC Northwest 2014). At least two eggs need to be found in a given sample for it to be counted as a positive sample and for the beach to be considered a potential spawning location. The 2013-2014 investigation found a single surf smelt egg in June of 2013 and another in February of 2014. These locations were marked as priority sampling areas for the ongoing forage fish spawning investigations. Appendix B provides additional detail on the occurrence of surf smelt along the shorelines of NAVBASE Kitsap Bangor.

In field surveys conducted along the shorelines of NAVBASE Kitsap Bangor from 2005 to 2008, surf smelt were detected from January through the mid-summer months along the Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). Surf smelt occur in these waters as distinct schools and do not appear to be attracted to, reside for any extended period at, or show preference toward any specific location along the waterfront. Instead, when these schools occur they appear to be using the nearshore environment as a migratory pathway, similar to salmonids.

##### OCCURRENCE AT SPE PROJECT SITES

As described for the LWI project sites, surf smelt occur in these waters as distinct schools and do not appear to be attracted to, reside for any extended period at, or show preference toward any specific location along the waterfront, although their occurrence appeared to be infrequent at these locations (Bhuthimethee et al. 2009).

#### 3.3.1.5.3. PACIFIC SAND LANCE

Pacific sand lance (*Ammodytes hexapterus*) is one of the most common and widely distributed forage fish in nearshore marine waters of Washington. In fact, it is possible that there are as many as thousands of tons of resident Pacific sand lance within these waters on a year-round basis (Bargmann 1998). As with other species of forage fish, Pacific sand lance are an important food resource for marine bird, mammal, and fish species (Penttila 2007). Although this species is common and widespread in Puget Sound, very little is known about the life history or biology of sand lance populations in Washington State. Stressors limiting sand lance reproduction include altered or degraded spawning habitats through mechanisms including physical burial under bulkhead-fill structures intruding into the intertidal zone from adjacent uplands, alteration of the normal supply and movement of beach sediments, oiling (Bargmann 1998) and other habitat elements (e.g., water and sediment quality). Appendix B provides additional life history information regarding Pacific sand lance along the Bangor shoreline.

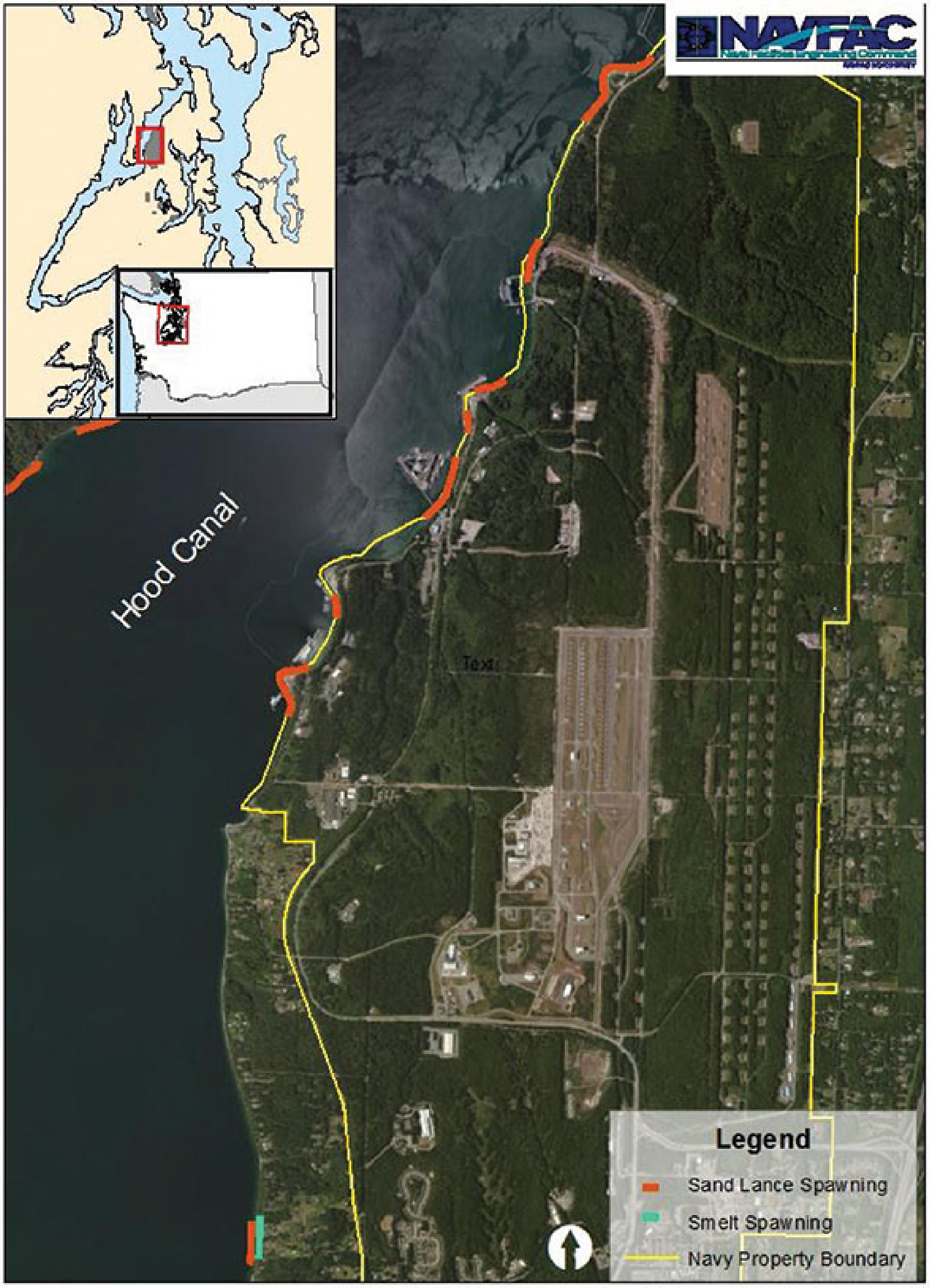
##### OCCURRENCE AT LWI PROJECT SITES

Appendix B provides additional life history information regarding Pacific sand lance along the Bangor shoreline. Similar to juvenile surf smelt, juvenile and adult sand lance were captured near both LWI project sites from January through the mid-summer months (SAIC 2006; Bhuthimethee et al. 2009). At the north LWI project site, Pacific sand lance spawning habitat has been documented along an estimated 1,000-foot (305-meter) length of the shoreline, extending from the proposed abutment location southward (Figure 3.3–4; WDFW 2013b). At the south LWI project site, spawning habitat has been documented along the shoreline approximately 500 feet (150 meters) north of the proposed abutment location, extending approximately 1,600 feet (488 meters) to the north (Figure 3.3–4; WDFW 2013b).

Similar to herring and surf smelt, nearshore surveys of Pacific sand lance likely documented the periodic occurrence of large schools of this species, but site-specific captures were inconsistent and did not suggest site-specific preferences (Bhuthimethee et al. 2009). Appendix B provides additional occurrence information regarding Pacific sand lance along the Bangor shoreline.

##### OCCURRENCE AT SPE PROJECT SITE

In field surveys conducted along the shorelines of NAVBASE Kitsap Bangor from 2005 to 2008, the between-year occurrence of Pacific sand lance at Carlson Spit, immediately south of the SPE project site, was somewhat more consistent than along other portions of the shoreline (SAIC 2006; Bhuthimethee et al. 2009; Appendix B). Although sand lance occurred more consistently between years at this location, they did not appear to be more abundant than in other survey areas. One reason for their consistency at the site may be that Pacific sand lance spawning habitat has been documented on both sides of Carlson Spit, extending northward to include intertidal habitats under the existing Service Pier causeway (Figure 3.3–4; WDFW 2013b). Whether the January to mid-summer month occurrence of Pacific sand lance is the result of adult fish accessing spawning habitats is currently unknown.




Data Source: WDFW 2014

**Figure 3.3–4. WDFW Documented Forage Fish Spawning at or near NAVBASE Kitsap Bangor**

### 3.3.1.6. OTHER MARINE FISH SPECIES

In addition to the salmonids and forage fish previously discussed, the marine environment along the Bangor shoreline also provides habitat for a variety of other species, including perches, gunnels, pricklebacks, pipefish, threespine sticklebacks, tubesnouts, and flatfish species (Navy 1988; SAIC 2006; Bhuthimethee et al. 2009). For example, more than 44 non-salmonid finfish species from at least 21 families were recorded from nearshore fish surveys within the last 15 years along the Bangor waterfront (Appendix A, Table A–1) (SAIC 2006; Bhuthimethee et al. 2009). The high species richness in these waters can be attributed to the habitat complexity of the nearshore environment. With some minor differences in habitat preferences, marine habitat conditions for salmonids would apply similarly to other marine fish species. Some species prefer structured habitats and are found in the vicinity of the pile supports for wharves and piers, whereas others prefer flat benthic habitats. With some seasonal variability, the majority of the fish identified in recent surveys along the Bangor shoreline occur in these habitats year round.

#### OCCURRENCE AT LWI PROJECT SITES

Peak occurrence of fish species included in the "other marine fish species" group generally begins in May, with a decline in abundance by September or October (Bhuthimethee et al. 2009). The most abundant species of non-salmon, non-forage fish, detected in recent surveys along the Bangor shoreline is the shiner perch (SAIC 2006; Bhuthimethee et al. 2009). Other species that commonly occur during summer months include various sculpin species, English sole, and gunnels, among others. At the north LWI project site in 2007 and 2008, English sole occurred at much lower abundances than at other locations along the waterfront (Bhuthimethee et al. 2009). Similarly, shiner perch, although occasionally occurring in large numbers, were less abundant at this location than at other survey sites. At the south LWI project site, English sole occurred at even lower numbers than at the north LWI project site. However, shiner perch were more abundant at the south LWI project site than at any other location along the shoreline. This is likely due to the large, flat, intertidal and shallow subtidal environment, supplied by warmer, nutrient-rich waters exiting at the Devil's Hole outlet. During summer months, the abundance of young shiner perch at this location suggest the site is utilized by adult female shiner perch for live-bearing their young.

#### OCCURRENCE AT SPE PROJECT SITE

Survey results from the two sampling locations that occur immediately south of the SPE project site did not indicate that this site was preferred by other marine fish species and diversity and abundance was limited (Bhuthimethee et al. 2009). However, many of the nearly 250 fish species documented in the marine waters of Hood Canal (Miller and Borton 1980; Burke Museum 2010) occur at depths much greater than could be effectively sampled by nearshore fish surveys (Schreiner et al. 1977; Prinslow et al. 1980; Bax 1983; Salo 1991; Bhuthimethee et al. 2009). Species that could occur in deeper offshore habitats affected by project actions likely include a variety of rockfish species, Pacific hake, walleye pollock, wolf eel, skates, sharks, ratfish, lanternfish, snailfish, and adult flatfish species. Piles that support a fouling community with both marine invertebrates and some attached vegetation likely serve as habitat for a variety of opportunistic fish species, including shiner perch, sculpin, gunnels, pricklebacks, and other opportunistic fish species. These structures are relatively shallow compared to habitats utilized by most adult rockfish species; therefore, it is unlikely that they utilize existing piles and other structures as habitat.

### 3.3.1.7. SALMONID MARINE HABITAT CONDITIONS

Marine and estuarine habitat requirements for juvenile and adult salmonids have been described by many authors (Fresh et al. 1981; Shepard 1981; Healey 1982; Levy and Northcote 1982; Weitkamp et al. 2000). Assessments of existing conditions and potential environmental consequences of proposed projects on key habitats are necessary to determine if potential effects would alter the habitats at a sufficient scale to affect long-term survival of the species. Since many of the habitats utilized by salmonids are also utilized by other marine fish species, this type of habitat analysis, as utilized for this Environmental Impact Statement (EIS), allows for a broader assessment across fish species. A characterization of baseline conditions of water and sediment quality, physical habitat and barriers, prey availability, aquatic vegetation, and underwater noise at both the LWI and SPE project sites as they relate to fish is provided in Section 2.0 of Appendix B.

### 3.3.1.8. CURRENT REQUIREMENTS AND PRACTICES

#### 3.3.1.8.1. REGULATORY COMPLIANCE

The ESA of 1973 (16 USC 1531 et seq.) requires federal agencies to consult with NMFS about activities proposed, funded, authorized, or undertaken that may affect federally listed fish species, and designated critical habitat. The MSA (16 USC 1801-1882 et seq.) only requires federal agencies to consult with NMFS if these proposed activities may adversely affect EFH. The MSA, through the EFH provision, protects the waters and substrate necessary for spawning, breeding, feeding, or growth to maturity of certain commercially managed fisheries species. The MSA is currently undergoing reauthorization and is expected to be reauthorized by the time of project construction. The analysis of EFH in this EIS is based on the provisions of the current MSA.

ENDANGERED SPECIES ACT

The ESA (16 USC 1531 et seq.) established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. An “endangered” species is a species in danger of extinction throughout all or a significant portion of its range. A “threatened” species is one that is likely to become endangered within the near future throughout all or in a significant portion of its range. The USFWS and NMFS jointly administer the ESA and are also responsible for the listing of species (designating a species as either threatened or endangered). The ESA allows the designation of geographic areas as critical habitat for threatened or endangered species. Section 7(a)(2) requires each federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency’s action “may affect” a listed species, that agency is required to consult with NMFS or USFWS, depending on the jurisdiction (50 CFR 402.14(a)).

As discussed in Section 3.3.1.3, seven threatened or endangered marine fish species have the potential to occur in the waters of northern Hood Canal. For fish potentially affected by the projects addressed by this EIS, the Navy is consulting with NMFS (Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, canary rockfish, and yelloweye rockfish) and USFWS (bull trout). Green sturgeon and Pacific smelt, two additional threatened or endangered species, were considered but eliminated from further analysis because they are not known to occur in Hood Canal (NMFS 2009; Longenbaugh 2010, personal communication).

*PRIMARY CONSTITUENT ELEMENTS FOR DESIGNATED PUGET SOUND CHINOOK AND HOOD CANAL SUMMER-RUN CHUM SALMON AND PROPOSED PUGET SOUND STEELHEAD CRITICAL HABITAT*

In the final rule designating critical habitat for 12 ESUs/DPSs of salmonids in Washington, Oregon, and Idaho, published on September 2, 2005 (70 FR 52630), NMFS defined the six primary constituent elements (PCEs) essential for conservation of these listed salmonids (including Puget Sound Chinook and Hood Canal summer-run chum). NMFS proposed critical habitat for Puget Sound steelhead (78 FR 2726) on January 14, 2013, and designated critical habitat on February 24, 2016 (81 FR 9251). NMFS re-evaluated the PCEs defined for Puget Sound Chinook and Hood Canal summer-run chum and determined that they were fully applicable to Puget Sound steelhead. However, whereas Puget Sound Chinook and Hood Canal summer-run chum designated critical habitat includes marine waters, critical habitat for Puget Sound steelhead within the Hood Canal Subbasin only includes occupied riverine habitat. All lands identified as essential and designated as critical habitat contain one or more of the PCEs. Although critical habitat occurs in northern Hood Canal, including waters adjacent to the base, NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 78 FR 2726; 81 FR 7226) from critical habitat designation for ESA-listed Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, and Puget Sound steelhead. However, since the project includes activities of sufficient nature and with the potential to impact critical habitat outside of the base boundaries it is important to assess the potential for project activities to impact these PCEs.

For the proposed projects, the nearest critical habitat designated for Puget Sound Chinook and Hood Canal summer-run chum salmonids is located immediately south and north of the NAVBASE Kitsap Bangor base boundary along the nearshore. In estuarine and nearshore marine areas, critical habitat includes areas contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 meters (100 feet) relative to MLLW (70 FR 52684). Puget Sound steelhead critical habitat includes occupied riverine habitats within the Hood Canal Subbasin. Within these areas, the PCEs essential for the conservation of these ESUs are those sites and habitat components that support one or more life stages, including:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
2. Freshwater rearing sites with: (i) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) water quality and forage supporting juvenile development; and (iii) natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large

wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;

4. Estuarine areas free of obstruction and excessive predation with: (i) water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; (ii) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;
5. Nearshore marine areas free of obstruction and excessive predation with: (i) water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and
6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

An analysis of potential impacts on nearshore marine fish habitats, including those listed in PCE Number 5, and offshore marine areas, including those listed in PCE Number 6, from construction and operation of each alternative of the two proposed projects is provided in Section 3.3.2. This habitat is important for juvenile Puget Sound Chinook and Hood Canal summer-run chum salmonids and returning adults. Since pile driving would be performed during the months when juvenile salmon are unlikely to be present, the underwater noise levels are unlikely to rise to the level that would preclude migration or force juveniles into deeper water where predation is more likely.

*ELEMENTS OF DESIGNATED PUGET SOUND ROCKFISH CRITICAL HABITAT*

On November 13, 2014, NMFS designated critical habitat for yelloweye rockfish, canary rockfish and bocaccio of the Puget Sound/Georgia Basin (79 FR 68041). In this notice NMFS did not use the PCE approach utilized for the designated Puget Sound Chinook, Hood Canal Summer-run chum salmon, or Puget Sound steelhead critical habitat descriptions. Instead, the designated critical habitat for the DPSs of these three species of rockfish was described as follows:

(a) Critical habitat is designated for the following DPSs in the following state and counties: WA–San Juan, Whatcom, Skagit, Island, Clallam, Jefferson, Snohomish, King, Pierce, Kitsap, Thurston, Mason.

(b) Critical habitat boundaries. In delineating nearshore (shallower than 30 m [98 ft]) areas in Puget Sound, we define designated critical habitat for canary rockfish and bocaccio, as depicted in the maps below, as occurring from the shoreline from extreme high water out to a depth no greater than 30 m (98 ft) relative to mean lower low water. Deepwater designated critical habitat for yelloweye rockfish, canary rockfish and bocaccio occurs in some areas, as depicted in the maps below, from depths greater than 30 m (98 ft). The critical habitat designation includes the marine waters above (the entire water column) the nearshore and deepwater areas depicted in the maps included in the listing.

(c) Essential features for juvenile canary rockfish and bocaccio. Juvenile settlement habitats located in the nearshore with substrates such as sand, rock and/or cobble compositions that also support kelp are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. Several attributes of these sites determine the quality of the area and are useful in considering the conservation value of the associated feature and in determining whether the feature may require special management considerations or protection. These features also are relevant to evaluating the effects of a proposed action in an ESA section 7 consultation if the specific area containing the site is designated as critical habitat. These attributes include: (i) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (ii) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities. Nearshore areas are contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 m (98 ft) relative to mean lower low water.

(d) Essential features for adult canary rockfish and bocaccio, and adult and juvenile yelloweye rockfish. Benthic habitats or sites deeper than 30 m (98 ft) that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rugose habitat are essential to conservation because these features support growth, survival, reproduction, and feeding opportunities by providing the structure for rockfish to avoid predation, seek food and persist for decades. Several attributes of these sites determine the quality of the habitat and are useful in considering the conservation value of the associated feature, and whether the feature may require special management considerations or protection. These attributes are also relevant in the evaluation of the effects of a proposed action in an ESA section 7 consultation if the specific area containing the site is designated as critical habitat. These attributes include:

(1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities;

(2) Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities; and

(3) Type and amount of structure and rugosity that supports feeding opportunities and predator avoidance.

As described previously for salmonid critical habitats, the NMFS description included that Section 4(a) of the ESA precludes military land from designation, where that land is covered by an Integrated Natural Resource Management Plan that the Secretary has found in writing will benefit the listed species. In addition, NMFS' rockfish critical habitat designation (79 FR 68041) specifically exempted the Bangor Naval Restricted Areas (Figure 1–2) from designation. It should be noted that designated rockfish critical habitat differs from salmonid critical habitat in that it includes deeper, offshore areas, as noted above. Since the project includes activities of sufficient nature and with the potential to impact critical habitat outside of these exempted areas, it is important to assess the potential for project activities to impact the physical or biological features described and considered essential for conservation.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSA (16 USC 1801-1881 et seq.), through the EFH provision, protects waters and substrate necessary for federally managed (commercially harvested) fisheries in Washington waters. Federal agencies are required to consult with NMFS about activities that may adversely affect EFH for species protected under the MSA. The MSA is currently undergoing reauthorization and is expected to be reauthorized by the time of project construction. The analysis of EFH in this EIS is based on the provisions of the current MSA.

In addition to the federal agencies that regulate threatened and endangered fish species, the PNPTT are co-managers with WDFW in regulating harvest management and supplementation programs for the Hood Canal summer-run chum ESU (71 FR 47180). The PNPTT include the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes, who have treaty rights to U&A fishing across the summer-run chum geographic range (71 FR 47180). Additional groups that contribute to and oversee recovery planning include the PSTRT and the HCCC, respectively (71 FR 47182).

#### 3.3.1.8.2. CONSULTATION AND PERMIT COMPLIANCE STATUS

As part of the regulatory and permitting process for the projects addressed by this EIS, the Navy submitted a Biological Assessment (BA) and EFH Assessment (EFHA) on March 10, 2015, and a revised BA on June 10, 2015, to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the Navy's proposed ESA effect determination (*not likely to adversely affect*) and MSA effect determination (*may adversely affect*) for the LWI preferred alternative, and indicating formal ESA consultation would be required for the SPE project. In a concurrence letter dated March 4, 2016, USFWS stated that the LWI and SPE project impacts to bull trout are not measurable and therefore insignificant.

#### 3.3.1.8.3. BEST MANAGEMENT PRACTICES AND CURRENT PRACTICES

Both the LWI and SPE projects include design measures to avoid or minimize environmental impacts (Section 2.3.1). BMPs and current practices proposed to avoid, minimize, or compensate for environmental impacts of the proposed projects on marine water resources (Section 3.1.1.2.3) and marine vegetation and benthic communities (Section 3.2.1.2.4) would also protect marine water, habitat, refuge, and food resources considered important to marine fish communities along the Bangor shoreline. In addition to previously mentioned practices, the following are essential for reducing impacts on marine fish:

- Construction activities with the greatest potential to harm fish, notably pile driving, will observe an in-water juvenile salmon work window. The Tidal Reference Area 13 (northern Hood Canal) in-water juvenile salmonid work window is currently July 15 to January 15, as outlined in WAC 220-660-330. The work window reflects best available science considerations for minimizing in-water project impacts on migrating juvenile salmonids, primarily Hood Canal summer-run chum.
- During construction, a vibratory pile driver would be used whenever possible to drive piles since it produces far less noise than an impact hammer, with a correspondingly

reduced impact on the surrounding environment. An impact hammer would be used to verify load bearing capacity ("proof load"), ensuring the piles are sufficiently stable to support their respective structures. Impact pile driving would not be used as the primary means to drive steel piles.

- For impact pile driving, a bubble curtain would be employed to decrease the amount of underwater pile driving noise. The bubble curtain is started prior to impact pile driving which would also allow fish an opportunity to move away from the immediate vicinity of the pile before full driving power is reached.
- BMPs will be implemented to control runoff and siltation and minimize impacts on surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2014).
- The Mitigation Action Plan (Appendix C) presents the marine habitat mitigation action that the Navy would undertake as part of the Proposed Action. This habitat mitigation action would compensate for impacts of the proposed projects on marine habitat and species.

### 3.3.2. Environmental Consequences

#### 3.3.2.1. APPROACH TO ANALYSIS

The evaluation of project-related effects on marine fish in this section considers impacts on potentially occurring marine fish species and those marine habitats on which they depend for some portion of their life history, including foraging, migration, and reproduction. This section also includes an analysis of project-related effects on seven ESA-listed marine fish species.

The evaluation of impacts on marine fish and their habitat is based on whether the species is listed under the ESA, the species has important fishery value as a commercial, tribal, or recreational resource (including EFH protected under the MSA), a specific group has particular sensitivity to the proposed activities, and/or a substantial or important component of the group's habitat would be lost. For threatened and endangered species, an effect determination of "may affect, likely to adversely affect" indicates an impact of concern.

National Oceanic and Atmospheric Administration (NOAA) Fisheries guidance (NMFS 1996, 1999) indicates that an assessment must include a definition of the biological requirements of a listed fish species. A description of these requirements, with an emphasis on habitats, is provided in Appendix B. The analysis below is designed to specifically address the potential project-related marine habitat impacts with respect to salmonids. Many of these same habitat indicators would apply similarly to habitat requirements for other marine fish species. Habitat factors considered important to the health and recovery of ESA-listed rockfish species were identified in the most recent Puget Sound rockfish status review (Drake et al. 2010) and the recent assessment of Puget Sound rockfish populations (Palsson et al. 2009).

Construction may impact marine habitats used by fish. The greatest impact during construction would occur during pile driving. Pile driving would exceed the underwater noise guideline and thresholds for fish, established for both behavior and injury, and result in the greatest potential for adverse impacts on marine fish. Further, positioning and anchoring construction barges, pile placement and driving would locally increase turbidity, disturb benthic habitats and forage fish, and shade marine vegetation in the immediate project vicinity during the construction time period. Pile driving impacts on salmonids would be minimized by adhering to the in-water work period (July 15 to January 15), when approximately 95 percent of all juvenile salmonids that occur in NAVBASE Kitsap Bangor nearshore waters are expected to be absent (SAIC 2006; Bhuthimethee et al. 2009). The proposed project may also adversely affect EFH for coastal pelagic species, salmon, and groundfish. This analysis was provided in detail in the EFH Assessment, and is summarized in this section. Adhering to the in-water work window for construction activities with the greatest potential to adversely affect fish, would reduce the exposure of ESA-listed fish and other fish to harmful underwater noise levels during construction.

In contrast to the short-term impacts of construction (ranging from one to two in-water work seasons, depending on the alternative), operational impacts on marine fish would be permanent. The portions of piers, or other structures, located in intertidal habitats would decrease habitat value and potentially represent a partial barrier to nearshore migrating fish, as they may alter their migration, including temporarily stopping or swimming through or around a given structure. However, depending on the size of the fish and the type of in-water structure, little or no delay in overall migration rate is anticipated in most cases. In addition, the presence of the piles and overhead decking could reduce the biological productivity of the benthic community and marine vegetation, both of which are habitats used by marine fish, including salmonids and juvenile rockfish. Proposed piers and other design aspects, including floating PSBs, would occur over intertidal and shallow subtidal habitats. As a result, a band of nearshore shade would occur from these structures across the migratory pathway for juvenile salmonids and forage fish.

The analysis for impacts on marine fish addresses both construction and operational impacts on habitat, migration, and predation of Pacific salmonids, forage fish, rockfish, and other marine fish. Due to similar nearshore marine habitat use, impact analyses for forage fish are considered similar to those detailed for salmonids. Rockfish and other marine fish generally use different habitat types than salmonids and are discussed separately.

### 3.3.2.2. LWI PROJECT ALTERNATIVES

#### 3.3.2.2.1. LWI ALTERNATIVE 1: NO ACTION

The LWI would not be built under the No Action Alternative and overall operations would not change from current levels. Therefore, the marine fish community would not be impacted under the LWI No Action Alternative.

#### 3.3.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

##### CONSTRUCTION OF LWI ALTERNATIVE 2

Marine habitats used by fish species that occur along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and other habitats, including piles used for structure and cover. The following sections describe how project-related effects on physical and biological factors would impact the abundance and distribution of marine fish that could occur along the Bangor waterfront during construction.

*Essential Fish Habitat*

As detailed in the EFH Assessment, the primary construction-related impacts of concern for EFH include underwater noise generated from pile driving, marine benthic and vegetation community disturbance, substrate disruption and turbidity from pile driving, barge anchoring and spud deployment, and water column and substrate shading from construction barges and structures (detailed in Sections 3.1.2, 3.2.2, and Appendix D). Shading can affect eelgrass and kelp beds, which provide suitable habitat areas for various life stages of some EFH species. Up to 6.2 acres (2.5 hectares) of nearshore marine habitat and 6.9 acres (2.8 hectares) of habitats in deep water would potentially be disturbed during construction of LWI Alternative 2 (Section 3.2.2.2.2). Of those 13.1 acres, approximately 3 acres (1.2 hectares) support marine vegetation communities. Measures for minimizing impacts on salmonids during construction activities, described above in Section 3.3.1.8.3 and in Appendix C, would similarly minimize impacts on EFH.

Because there is the potential for nearshore construction-related impacts on EFH, construction of LWI Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. However, based on a review of the EFH species known to occur in Hood Canal, findings from site-specific fish surveys pertaining to EFH species occurrence in waters along the Bangor waterfront, review of the life histories, habitat requirements, and potential conservation measures from the FMPs, as well as review of the potential project impacts and mitigation measures that were developed to prevent adverse effects on ESA-listed fish species and their habitats, the current project approach and mitigation measures adequately address concerns pertaining to the potential for adverse construction-related effects on EFH.

*Threatened and Endangered Fish and Species of Concern*

Due to the similarity of life histories within ESA-listed species groups (salmonids and rockfish), impacts on ESA-listed species are discussed by listed species group rather than as individual species. As a result, the species group *ESA-Listed Hood Canal Salmonids* includes the following: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout. The species group *ESA-Listed Hood Canal Rockfish* includes bocaccio, yelloweye rockfish, and canary rockfish.

*ESA-Listed Hood Canal Salmonids*

The following paragraphs for ESA-listed Hood Canal salmonids provide an overview evaluation on habitats that are described in more detail below. The potential impacts of the proposed project on Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout and the nearshore habitats they use are discussed below. Some project-related impacts could indirectly impact salmonids through alteration of nearshore habitats (e.g., aquatic vegetation disturbance), whereas other impacts can directly affect a given fish should it occur during the construction period (e.g., underwater noise). Juvenile salmonid species that are dependent on shoreline habitats as a migratory pathway (Appendix B) would not be able to avoid nearshore construction activities as easily as adults. However, up to 95 percent of juvenile salmon potentially occurring along the NAVBASE Kitsap Bangor shoreline would not be present during pile driving due to observance of the in-water work window (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009).

*Other Salmonids*

Larger juvenile salmonids, including coho and ocean-type Chinook, are less dependent on the shallow, nearshore shoreline for migration and refuge than smaller pink and chum salmon. Tagging investigations have shown that juvenile coho and Chinook distribution and movement patterns are not well known (Chamberlin et al. 2011; Rohde 2013), but they have extended intra-basin residence times and may utilize these habitats for extended rearing periods, not just migratory corridors. Although nearshore in-water construction may result in these larger juvenile salmonids migrating around the activity, this change is not anticipated to substantially delay their migration.

Salmonid Marine Habitat Conditions

Impacts on marine habitats used by ESA-listed Hood Canal salmonids would be similar for all listed and non-ESA-listed salmonid species.

Water and Sediment Quality

As discussed in Section 3.1.2.2.2, construction-related impacts on water quality from LWI Alternative 2 would be limited to temporary and localized changes associated with resuspension of bottom sediments during pile and in-water mesh installation, barge and tug anchoring, and propeller wash. While large increases in turbidity have the potential to damage fish gills, the proposed project would only result in small-scale increases of suspended sediments (Section 3.1.2.2.2) and would not likely result in gill tissue damage to salmonids. Studies investigating similar impacts on steelhead and coho salmon from larger scale sediment dredging operations have shown that increased turbidity levels from these activities did not cause salmonid gill damage, although other adverse effects were evident (Redding et al. 1987; Servizi and Martens 1991). Redding et al. (1987) found that coho and steelhead were more susceptible to bacterial infection and displayed reduced feeding rates when exposed to elevated turbidity levels. Servizi and Martens (1991) found that coho were more susceptible to viral infections when exposed to elevated turbidity, and postulated that other impacts include reduced tolerance to environmental changes. Turbidity attributed to the bubble curtain is dependent on whether the bubble curtain unit design is confined or unconfined (Section 3.1.2.2.2). Because sediment disturbance is expected to be temporary and intermittent in nature, and fish are expected to avoid the immediate vicinity of construction activities, no long term effects to salmonid fitness are expected. However, elevated turbidity could temporarily decrease the availability of prey in the area, or the ability of salmonids to detect and capture prey species.

Because concentrations of organic matter in NAVBASE Kitsap Bangor sediments are low (Section 3.1.1.1.3), resuspension of these sediments is not expected to alter or depress DO below levels required by water quality standards. In surveys conducted along the Bangor waterfront from 2005 to 2006, DO was measured at levels below the Extraordinary Quality (EQ) standard of 7.0 mg/L, but not below the level considered to have adverse impacts on fish (5 mg/L) (Newton et al. 2002). Construction of LWI Alternative 2 would not result in violations of water quality standards for DO or cause sufficient local decrease in DO that would impact fish health in the project vicinity.

Resuspended sediments could cause the release of sediment-bound contaminants to near-bottom waters. However, sediments at both LWI locations contain low concentrations of organic carbon (i.e., TOC) and are characterized as having contaminants levels below applicable state standards (Section 3.1.1.1.3). Therefore, increases in chemical contaminant concentrations in marine waters as a result of sediment resuspension during pile installation would be minor. Because suspended sediment and contaminant concentrations would be low, and exposures would be limited to the six-month, in-water construction period during each of the two in-water construction years, localized, acute, or chronic toxicity impacts would not occur.

Another possible source for construction-related impacts on water quality would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could impact bottom sediments, with larger debris potentially acting as an obstruction to fish movement. The Navy would implement measures to prevent the discharge of construction debris into marine waters (Section 3.1.1.2.3). The facility response plan for the Bangor waterfront provides for responses to potential spills. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups, in accordance with the debris management procedures that would be developed and implemented per the Mitigation Action Plan (Appendix C).

Construction of LWI Alternative 2 would not impact water temperature or salinity because construction activities would not discharge a waste stream. Steel piles installed for LWI Alternative 2 would be inert and would not contain creosote or other contaminants that could be toxic or biologically available.

Stormwater runoff potential impacts and protective measures would be similar to those described in Section 3.1.2.2.2, under Water Quality, for water quality impacts. Construction activities associated with LWI Alternative 2 would not result in major impacts on water temperature or salinity and would not violate any water quality standards.

Although some level of localized changes in sediment grain size is expected during construction activities for LWI Alternative 2, such as fine-grained sediments dispersing and settling outside the project site, impacts on sediment quality would be limited and localized to the general project area (Section 3.1.2.2.2). Construction activities would not discharge contaminants or otherwise appreciably alter the concentrations of trace metal or organic contaminants in bottom sediments. Although sediments could be adversely impacted by oil spills during in-water construction, the construction contractor would be required to prepare and implement a spill response plan (e.g., SPCC plan). If an accidental spill should occur, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. These cleanup procedures would minimize impacts on the surrounding environment.

Physical Habitat and Barriers

For LWI Alternative 2, up to 54 piles would be driven along a 280-foot (85-meter) linear stretch extending from the shoreline to the floating PSBs at the north LWI location, and up to

82 piles would be driven along a 730-foot (223-meter) linear stretch extending from the shoreline to the floating PSBs at the south LWI location. At each of these two locations, construction of the LWI abutments would require excavation below MHHW. The abutment stair landings and the placement of riprap would also occur below MHHW. A coffer dam would be utilized to minimize project impacts. The coffer dam would be 140-feet (43 meters) long for the north LWI and 160-feet (49 meters) long for the north LWI stairs. Along the south side, the coffer dam would be190-feet (58 meters) long for the LWI and 160-feet long for the LWI south stairs. This work would be done at low tide and is, therefore, likely to have minimal effect on fish movement in the project vicinity. The abutment piles would be driven "in the dry" and, therefore, are not included in the in-water noise analysis. Hughes (2015) indicates that the supratidal region, which occurs between the normal tidal range and extreme high tides, is used by salmonids and forage fish for migration. These habitats are inundated for short periods. In areas where construction of the two abutments occurs in supratidal habitats, these activities would result in the loss of physical habitat and function of these habitats for migration on an infrequent basis.

The pier length would extend across much of the nearshore juvenile salmonid migratory pathway (280 feet at the north LWI and 730 feet at the south LWI), defined as occurring from 12 feet (4 meters) above MLLW to 30 feet (9 meters) below MLLW. The dock attached to each pier would be anchored with four piles (included in the pier pile counts) and each gangway would be anchored with two piles. The relocation of the PSBs would remove one anchor in the vicinity of each pier. In this area, barrier impacts on salmonids would be associated with nearshore construction activity, installation of the in-water mesh, lighting of the construction area and construction platforms, vessel shading, barge anchoring and spud/anchor dragging, underwater noise, and localized, temporary plumes of increased suspended solids produced during pile-driving, anchoring, and mesh installation activities.

During construction of LWI Alternative 2, the impact of physical barriers on marine fish would be greatest in the habitats used by juvenile salmonids as a migratory pathway. Relative to younger age-classes, adult salmonids of all species have much greater mobility, and are unlikely to experience the same shallow-water barrier effect as nearshore-dependent juvenile salmonids. In general, adult salmonids would likely migrate around nearshore construction activity, with little or no overall delay in their movements.

Nightingale and Simenstad (2001a) cite multiple studies that indicate smaller juvenile salmon, notably fry, migrate within shallow nearshore waters. These studies have shown that smaller juveniles (e.g., fry less than 2 inches [5.1 centimeters]) migrate along the shoreline in waters less than 3 feet (0.9 meter) in depth (Schreiner 1977; Bax 1982; Whitmus 1985). Simenstad et al. (1999) refer to shallow-water habitat as "that portion of the nearshore estuarine and marine environment habitually occupied by migrating salmon fry (i.e., approximately 1 to 3 inches [2.5 to 7.6 centimeters] long), which includes the intertidal zone to approximately -6 feet (-2 meters) MLLW." The most numerically abundant juvenile salmonids that occur along the waterfront at these smaller sizes are chum and pink salmon (SAIC 2006; Bhuthimethee et al. 2009). Larger juvenile salmonids (e.g., coho) move further offshore into deeper waters (Bax et al. 1980) where they may encounter larger piers, wharves, and bulkheads (Nightingale and Simenstad 2001a).

Pile driving activities would be conducted during the in-water work window (July 15 to January 15). Fish surveys along the Bangor shoreline in the 1970s and 2005 to 2008 indicated that most (approximately 95 percent) of the juvenile salmonid migration is complete by this time (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009). However, other in-water, construction-related impacts could occur outside this window, and may increase turbidity, nearshore shade, or in-water noise (from vessels and cranes). Mesh installation in particular would serve as at least a partial disturbance to juvenile migration. Any avoidance response or similar behavior could result in migration delays or alterations from normal migration routes of nearshore-occurring, out-migrating juvenile salmonids. Returning adult salmonids would likely alter their migration patterns somewhat to avoid any active in-water construction activity. The potential barrier affect would be minor and not prevent adult salmonids from migrating southward along the shore to their natal streams for spawning. Although pile driving activities during the construction of LWI Alternative 2 would occur at a time when salmonids are least abundant, other construction activities would represent an increase of in-water barriers encountered by salmonids potentially present during the construction period.

<u>Biological Habitat</u>

*Prey Availability.* As discussed in Appendix B, both benthic invertebrate prey and forage fish are important food resources for juvenile salmonids. While this section addresses construction-related impacts from LWI Alternative 2 to the localized benthic prey community, the discussion of impacts on the forage fish community is provided below. Construction of LWI Alternative 2 would result in localized and temporary reductions of the benthic community during pile placement and other construction-related disturbances (Section 3.2.2.2.2). During the construction period, juvenile salmonids could experience minor loss of available benthic prey at both LWI locations due to disturbances from abutment construction, pile installation, in-water mesh installation, and barge use of spuds and anchors (Section 3.2.2.2.2). Benthic organisms that are disturbed during ongoing in-water construction would be expected to be reestablished within a 3-year period (CH2M Hill 1995; Romberg et al. 1995; Parametrix 1994a, 1999; Anchor Environmental 2002; Vivan et al. 2009). Total anticipated benthic impacts would last 5 years (2 construction years, 3 years for reestablishment), but would be limited in scope (Section 3.2.2.2.2).

*Aquatic Vegetation.* The aquatic vegetation habitat of principal concern for juvenile salmon foraging and refuge is eelgrass (*Zostera* sp.) (Simenstad et al. 1999; Nightingale and Simenstad 2001a,b; Redman et al. 2005). Intertidal and subtidal areas with extensive areas of eelgrass provide habitat for amphipods, copepods, and other aquatic invertebrates (Mumford 2007) used by juvenile salmonids as food resources. Copepods and other zooplankton represent the major food base for Puget Sound juvenile fish (Simenstad et al. 1979), including salmonids. In addition, during these small, vulnerable life stages juvenile salmonids use these nearshore vegetated habitats as a refuge from predators during out-migration. The two largest eelgrass beds along the Bangor shoreline occur near Devil's Hole and Cattail Lake, but a relatively narrow band of eelgrass occurs along nearly the entire shoreline (SAIC 2009).

A maximum of 1.1 acres (0.43 hectare) of eelgrass beds and 2.6 acres (1.1 hectares) of green macroalgae beds would be impacted during construction of LWI Alternative 2 (Table 3.2–3)

(Section 3.2.2.2.2). Impacts would be associated with in-water construction activities during pile driving, steel plate anchoring, mesh installation, and decking installation. From these activities, turbidity would affect nearby eelgrass and green macroalgae beds, potentially resulting in plant loss.

The presence of the overwater barges and structures and the shade they would cast during construction would limit the productivity of aquatic vegetation in the immediate project vicinity. During construction, eelgrass habitats would be affected, with some loss of function, due to barge shading, propeller wash, and anchoring (Section 3.2.2.2.2). Although the proposed construction activities would result in impacts on eelgrass populations at both LWI locations, the proposed compensatory aquatic mitigation action (Appendix C, Section 6.0) would compensate for impacts on eelgrass.

*Underwater Noise.* Construction of the LWI Alternative 2 structures would result in increased underwater noise levels in adjacent areas of Hood Canal, due primarily to the installation of piles supporting the two towers at the south LWI, the tower at the north LWI, and associated dolphin piles. Under LWI Alternative 2, up to a total of 256 in-water piles would be driven (Table 2–1). While pile driving is the construction action that would result in the greatest range over which fish could be affected, it would require no more than 80 days to complete, during a single in-water work season, with impact proofing conservatively lasting from 83 to 111 minutes per day.

In addition to the pile driving, other in-water work includes removing and relocating anchors and placing additional PSBs. Vessel activity required for in-water construction would result in temporary noise and visual disturbance in the immediate vicinity of some of these vessels. Barge activity during construction of the pier and pier decks, is also proposed. For LWI Alternative 2, an additional in-water work season would be required to complete marine construction, including steel plate anchoring and mesh installation at each pier. Additional vessel activity required for in-water construction would result in temporary noise and visual disturbance in the immediate vicinity of some of these vessels.

Appendix D describes the source levels that pile driving is expected to generate, as well as attenuation of these levels over increased distance. Source levels used for calculations under this Alternative for 24-inch (60-centimeter) steel piles were 210 decibel (dB) peak re 1 μPa at 33 feet (10 meters) and 193 dB root mean square (RMS). The RMS value is normalized over the event and thus is representative of an "average" measure of sound. To reduce underwater noise levels and associated impacts on underwater organisms during impact proofing of steel piles, a bubble curtain would be deployed. Therefore, an 8 dB reduction in sound levels was assumed during proofing activities. The estimated duration of impact pile driving would range from 83 to 111 minutes per day. The source level assumed for vibratory driving is 161 dB RMS re 1 μPa at 33 feet.

The underwater noise threshold for fish injury from a single impact hammer pile strike is at a sound pressure level (SPL) of 206 dB peak (Fisheries Hydroacoustic Working Group 2008). However, most pile driving would be accomplished using vibratory methods. Assuming no more than 200 impact strikes would be required to proof each steel pile, the maximum number of strikes on any active pile driving day would be 2,000. The cumulative Sound

Exposure Level (SEL) threshold accounts for the energy accumulated over a time period of exposure. The applicable criterion for injury to fish would be 187 dB cumulative SEL for a fish greater than or equal to 2 grams in weight and 183 dB cumulative SEL for a fish less than 2 grams in weight (Fisheries Hydroacoustic Working Group 2008). As reference points of total fish length at 2 grams weight in Puget Sound, including some variability due to fish health and food availability, juvenile Chinook salmon are approximately 2.7 to 2.8 inches (68 to 70 millimeters) (Tynan 2013, personal communication) and juvenile English sole are 2.4 to 2.8 inches (60 to 70 millimeters) (Hunt 2005).

In addition to the injury thresholds, Hastings (2002) recommended an underwater noise guideline for behavioral impacts on fish, including startle response, at a level of 150 dB RMS. This behavioral guideline applies to both impact hammer and vibratory pile driving. During pile driving, the associated underwater noise levels could result in a behavioral response, including project area avoidance. To reduce underwater noise levels and associated impacts on underwater organisms during active impact pile driving, a bubble curtain would be deployed. In addition to the benefit of a bubble curtain to attenuate underwater noise, the bubble curtain would be started prior to impact pile driving to allow fish an opportunity to move away from the immediate vicinity of the pile before full driving power is reached.

Table 3.3–3 details the calculated effect ranges for pile driving activities that would occur under LWI Alternative 2; Figures 3.3-5a and 3.3-5b illustrate these ranges.

**Table 3.3–3. LWI Alternative 2 Fish Threshold and Guideline Levels and Effect Ranges for the Operation of Impact Hammer and Vibratory Pile Drivers Driving a 24-inch Steel Pile**

| Fish Threshold and Guideline Levels[1, 2] | LWI Alternative 2 Effect Ranges 24-inch Steel Pile[3] |
|---|---|
| 206 dB peak, impact hammer (injury)[3] | 18 feet (5 meters) |
| 187 dB SEL (injury to fish ≥2g)[3] | 607 feet (185 meters) |
| 183 dB SEL (injury to fish <2g)[3] | 1,122 feet (342 meters) |
| 150 dB RMS, impact hammer (behavioral for all fish) | 7,068 feet (2,154 meters) |
| 150 dB RMS, vibratory driver (behavioral for all fish) | 178 feet (54 meters) |

dB = decibel; g = gram; RMS = root mean square; SEL (for this table) = Cumulative Sound Exposure Level

1. Underwater noise thresholds are taken from Fisheries Hydroacoustic Working Group (2008).
2. The underwater noise guideline for behavior is taken from Hastings (2002).
3. Bubble curtain assumed to achieve an average of 8 dB reduction in sound pressure levels.

To minimize underwater noise impacts during pile driving, vibratory pile drivers would be used to the maximum extent practicable. As noted above, no injury threshold has been identified for vibratory pile driving (Fisheries Hydroacoustic Working Group 2008). It is possible that the impact and vibratory pile drivers would operate concurrently at times. In this case, because the source levels for the impact driver are so much greater (several orders of magnitude) than source levels for vibratory drivers, the combined noise levels generated by concurrent operation of the two types of drivers would not be measurably greater than those generated by operation of the impact driver alone. Therefore, the above impact analysis of noise from operating the impact driver represents the worst-case noise impacts for pile driving for the Proposed Action.

Based on a recent laboratory study on juvenile Chinook salmon, Halvorsen et al. (2012a) attempted to provide quantitative data to define the levels of impulsive sound that could result in the onset of barotrauma to fish. The sounds produced in the study were designed to mimic the impulsive sounds generated by an impact hammer striking a hollow steel pile. Juvenile Chinook salmon were exposed to one of eleven impulsive sound treatments that varied in total energy ($SEL_{CUM}$). The total number of strikes, and therefore sound duration, was also investigated. Fish were either exposed to simulations of 1,920 strikes (48 minutes) or 960 strikes (24 minutes). Following exposure to the respective impulsive sound exposures, each fish was examined for barotrauma injuries both externally and internally. As predicted, higher energy exposures resulted in higher mortality and injury than lower energy exposures.

The authors concluded that the severity of injury to fish exposed to impulsive sound cannot be predicted from the $SEL_{CUM}$ alone in an exposure consisting of many impulsive events and should consider the energy in the individual impulsive sounds ($SEL_{SS}$), as well the number of impulses that constitute the exposure. The authors also stated that it is not possible to compare their work with caged fish studies which are unable to control the physiological state of the test fish at exposure or any aspects of sound presentation (e.g., number of impulsive sounds, $SEL_{SS}$ or $SEL_{CUM}$). Based on their findings, Halvorsen et al. (2012a) concluded that a minimum $SEL_{CUM}$ of 210 dB was required to inflict injury on these fish, in contrast to the 187 dB or 183 dB set by the Fisheries Hydroacoustic Working Group. However, as indicated by PFMC (2014b), the Fisheries Hydroacoustic Working Group has not revised its criteria because of several concerns: (1) the study used undescribed energetic costs to weight the injuries; (2) the study was unable to assess the effects of noise exposure on the inner ear, an important sensory system that can be damaged by exposure to sounds; and (3) although eye hemorrhaging and bruising of the spleen were observed, they were excluded from the analysis because they were inconsistently scored and recorded.

Another recent study by Halvorsen et al. (2012b) examined a variety of representative species having different swim bladder characteristics to evaluate effects from impulsive sound. The studies included species with an open swim bladder (lake sturgeon – an appropriate proxy for salmonids), a closed swim bladder (Nile tilapia – an appropriate proxy for rockfish), and no swim bladder (hogchoker – an appropriate proxy for sand lance). Results indicated that physiological responses to simulated pile driving noise at 216 dB SEL (higher than the 214 dB cumulative SEL [$SEL_{CUM}$] that may be reached under LWI Alternative 2) varied widely, from renal hemorrhaging and swim bladder ruptures to (Nile tilapia only) to moderate injuries including hematomas and partially deflated swim bladders (both Nile tilapia and lake sturgeon). The hogchokers, representative of species lacking a swim bladder, displayed no external or internal injuries as a result of exposure to simulated pile driving noise (Halvorsen et al. 2012b). None of the fish used in the study treatments suffered acute mortality as a result of exposure to the simulated pile driving sounds. It is important to note that the study conditions attempted to replicate sound levels at a range of 32 feet (10 meters); however, other factors such as existing ambient noise and open waters which would allow fish to exhibit natural behaviors, including avoidance of aversive stimuli, were not incorporated.

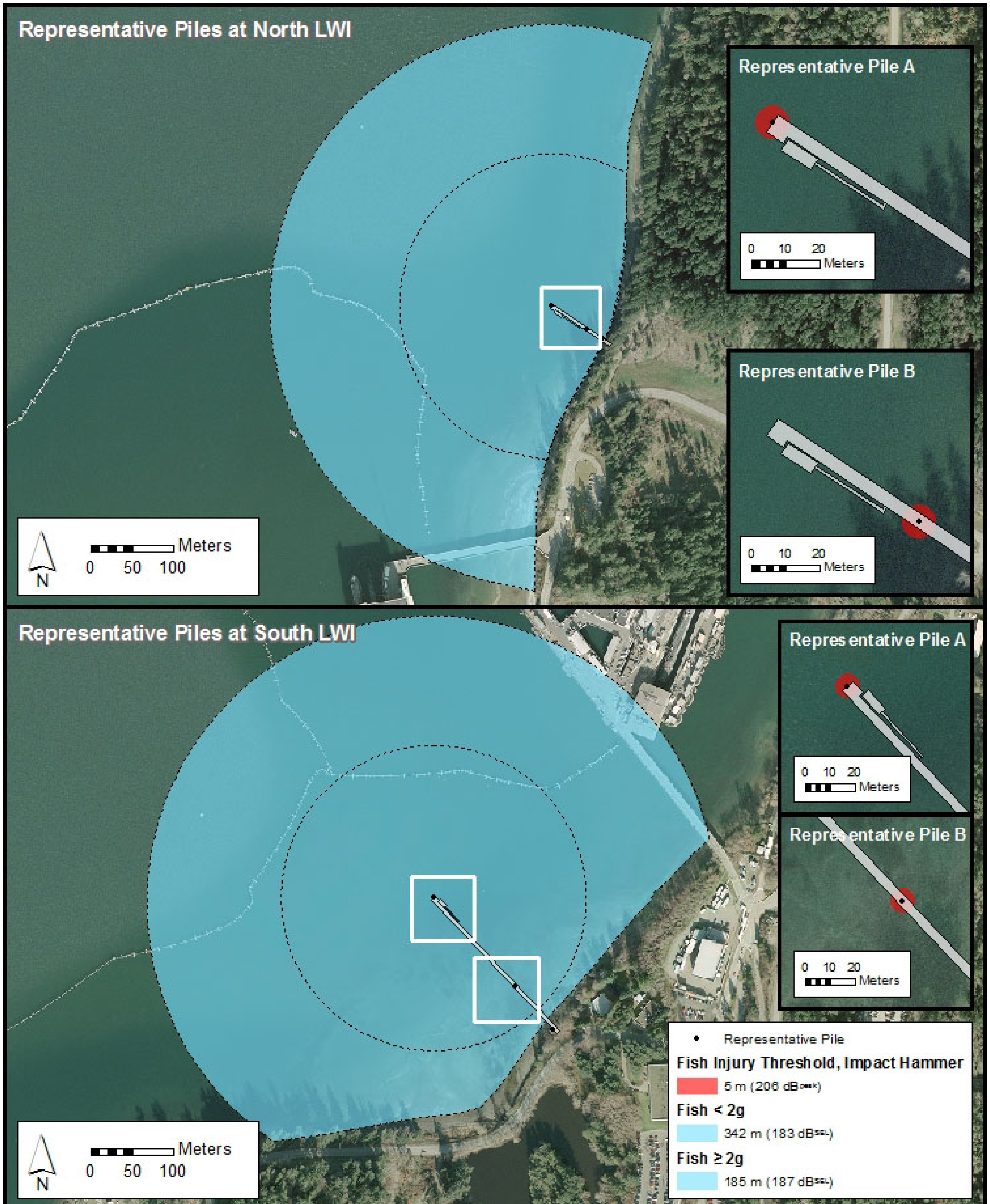



**Figure 3.3-5a. Representative View for Fish Injury Threshold due to 24-inch Hollow Steel Pile Driving Noise during LWI Construction, Alternative 2**

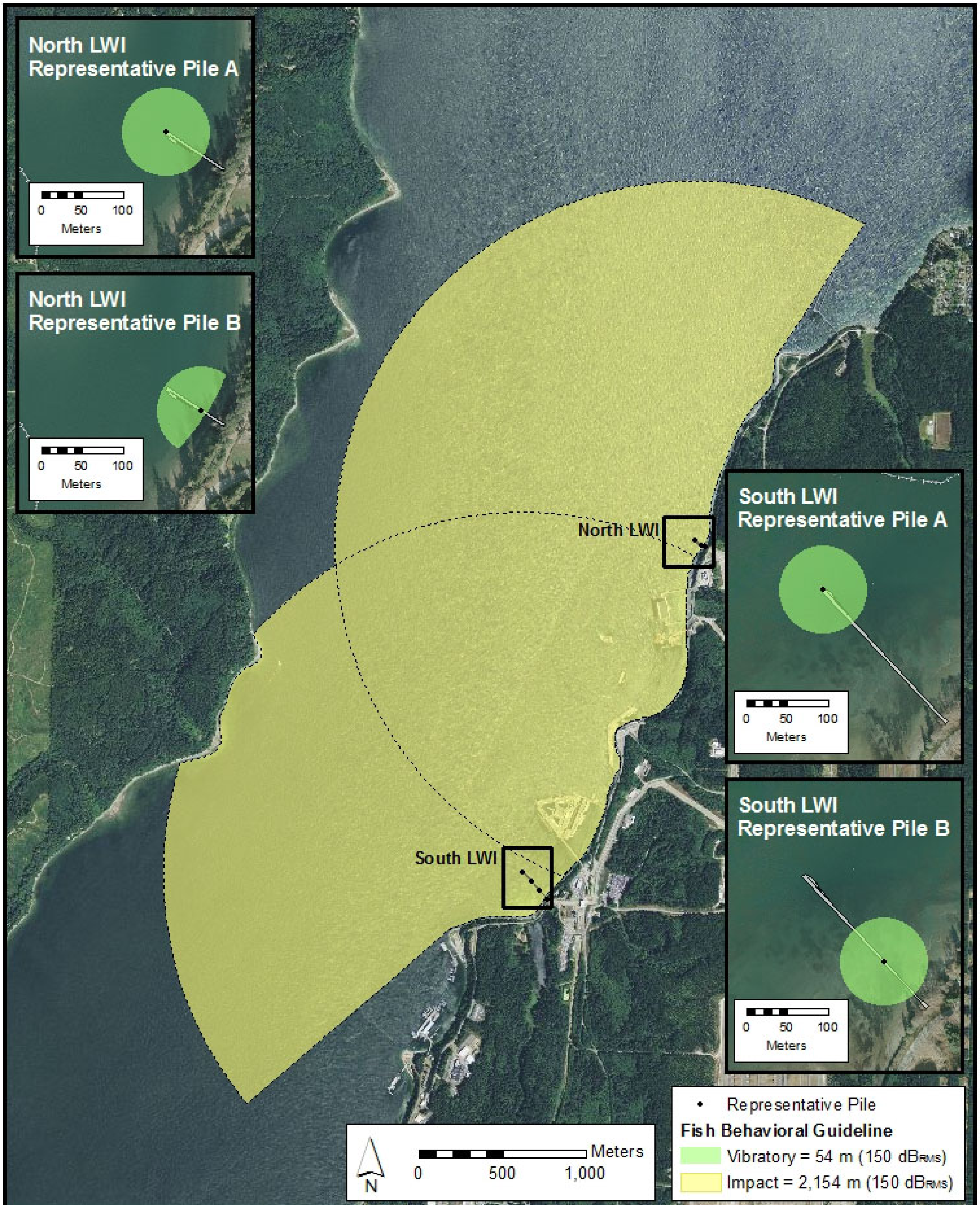



**Figure 3.3-5b. Representative View for Fish Behavior Guideline due to 24-inch Hollow Steel Pile Driving Noise during LWI Construction, Alternative 2**

Fish with swim bladders are more susceptible to barotraumas from impulsive sounds (sounds of very short duration with a rapid rise in pressure) because of swim bladder resonance (vibration at a frequency determined by the physical parameters of the vibrating object). When a sound pressure wave strikes a gas-filled space, such as the swim bladder, it causes that space to vibrate (expand and contract) at its resonant frequency. When the amplitude of this vibration is sufficiently high, the pulsing swim bladder can press against, and strain, adjacent organs, such as the liver and kidney. This pneumatic compression may cause injury, in the form of ruptured capillaries, internal bleeding, and maceration of highly vascular organs (CALTRANS 2002, Halvorsen et al. 2012b). Halvorsen et al. (2012b) noted that the results of the 2012 study support an argument that fishes appear to be less susceptible to energy from impulsive pile driving than is currently allowed before the onset of physiologically significant injuries and an increase in the current criteria may be warranted.

In estimating the potential effects to fish from noise generated by impact proofing, the acoustic model assumed 200 strikes per pile with up to 10 piles being proofed per day for the cumulative range to effect. However, the actual number of piles being driven in a given day, and the number of strikes per pile, may be significantly lower than what was modeled. Thus, the actual range to effect could be smaller than what is presented in Table 3.3–3 above.

Further, when the model applies the 187 or 183 dB re 1 $\mu Pa^2$sec SEL injury thresholds it assumes fish are remaining within the range of effect during the entirety of a given 24-hour period. In other words, fish that remained within the calculated range for an entire day of pile driving activity would accumulate energy from every impact strike. Individuals that spent part of the day outside of this range due to avoidance or natural behavioral motivations would accumulate a lesser amount of energy, and may not reach the 187 or 183 dB re 1 $\mu Pa^2$sec SEL injury thresholds. In a review of studies investigating the behavioral response of fish to impulse sounds such as those generated from pile driving, PFMC (2014b) found that fish response was variable. Some studies showed little or no avoidance response to impulsive sound at frequencies greater than 100 Hz (as reviewed in PFMC 2014b) and no observable behavioral response by caged coho salmon in the vicinity of impact pile driving (Ruggerone et al. 2008). Other studies found that impulse sounds were avoided (as reviewed in PFMC 2014b), or resulted in increased swimming speeds (Mueller-Blenkle et al. 2010) or other altered behavior (Feist et al. 1992; Fewtrell and McCauley 2012). As indicated by these studies, it is possible that fish in the project vicinity would display a range of behavioral responses during pile driving. NMFS (2012) stated that use of the SEL thresholds is less relevant for fish that typically are not expected to remain within the area during the entire duration of pile driving[1].

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[1] NMFS evaluated pile driving impacts on Atlantic and shortnose sturgeon in a 2012 biological opinion and concluded "*...in order for this criteria [SEL] to be relevant, we would need to expect that shortnose sturgeon would remain in that area for the entire duration of the pile driving activity. This is not a reasonable expectation because it does not take into account any behavioral response to noise stimulus. We expect sturgeon to respond behaviorally to noise stimulus and avoid areas above their noise tolerance. This behavioral response is expected to occur at noise levels of 150 dB re 1µPa RMS… we have determined that when assessing the potential for physiological impacts, the 206 dB re 1µPa peak criteria is more appropriate. This represents the instantaneous noise level. Thus, considering the area where this noise level will be experienced would account for fish that were in the area when pile driving started or were temporarily present in the area*."

When assessing the potential for physiological impacts, the 206 dB re 1 μPa peak threshold for impact pile driving is more appropriate as it represents the instantaneous noise level versus a cumulative noise level that would be practically impossible to receive under real world conditions. Pile driving of all types produces particle motions that may be perceptible to fishes' lateral line, resulting in some degree of avoidance behavior for fish that are both close to the pile being driven and deeper in the water column. As discussed in the preceding paragraph, studies of fish response to impulse noise vary in their observation from an immediate startle or avoidance response, to little or no response. Fish that display a startle response and avoid the underwater noise source would be exposed to less underwater noise than fish remaining near the noise source.

If fish remain in the vicinity of pile driving for an extended period of time, they may be vulnerable to injury or potential mortality. During 2012–2013 monitoring of pile driving activities at EHW-2, one mortally wounded sculpin was documented during impact pile driving (Hart Crowser 2013a). Although several large schools of herring occurred throughout the monitoring period, no other stunned fish were detected (Navy 2013). During the 2014–2015 monitoring of pile driving activities at EHW-2, some fish stuns and mortalities were detected (Hart Crowser 2015). On five occasions in August and September, 2014, large schools of herring coincided during impact and vibratory pile driving of 36-inch piles. The number of fish detected ranged from one to approximately 100. Barotrauma was detected on the few fish evaluated during the study (Hart Crowser 2015).

In general, mortalities are limited to small fish (Yelverton et al. 1975; Fisheries Hydroacoustic Working Group 2008), although with some variation in fish response as discussed above. Many of the fish close to piles when pile driving begins are expected to react by leaving the area, and any individuals starting to approach the piles during pile driving would most likely avoid the area (Pearson et al. 1992; McCauley et al. 2000; LGL Ltd. 2008; NMFS 2012). On sensing pile driving noise at reduced intensity during soft starts fish may move away from the immediate vicinity of the activity before full driving intensity is reached, thereby reducing the likelihood of exposure to sound levels that could cause injury or further behavioral disturbance (NMFS 2012). This behavior combined with the intermittent occurrence of proofing for a maximum of just under 2 net hours per day suggests that while physiological or behavioral impacts may occur, they would be limited in duration, intensity, and continuity.

Impact driving of 24-inch (60-centimeter) steel piles has the potential to cause injury if the sound pressure waves injure or rupture the swim bladder or cause barotrauma. However, fish (including ESA-listed salmonids and rockfish) are not expected to be present within the 18-foot (5-meter) peak injury zone at the beginning of pile driving based on the small size of the zone, the low likelihood of their occurrence in the area, and the activities such as pile placement which would take place prior to the start of actual driving. Fish in the area where the behavioral disturbance guideline is exceeded may display a startle response during initial stages of pile driving and avoid the immediate project vicinity during construction activities, including pile driving. Although pile driving would adhere to the in-water work window (July 15 to January 15) to minimize underwater noise impacts to the large schools of outmigrating juvenile salmonids, some salmonids, including juvenile coho and juvenile and subadult Chinook salmon, may transit through the area during periods of pile driving.

No population-level impacts for Puget Sound Chinook salmon, Hood Canal summer-run chum, Puget Sound steelhead, and bull trout are anticipated, and the continued survival of these species would be unaffected.

Summary of Impacts and ESA-Listed Salmonid Determination

The majority of pile driving associated with LWI Alternative 2 would be conducted using a vibratory driver, which would not generate noise levels sufficient to cause injury to fish under the existing criteria. If impact proofing is required, it would be temporary and intermittent in nature, lasting for a net total of two hours or less on any given day. In estimating the potential impacts to fish from impact pile driving noise, the acoustic model assumes 200 strikes per pile. However, the actual number of strikes per pile may be significantly lower than what was modeled. Further, when the model applies the 187 or 183 dB re 1 $\mu Pa^2$sec SEL injury thresholds it assumes fish are remaining within the range of effect during the entirety of a given 24-hour period. In other words, a fish that remained within the calculated range to effects (Table 3.3–3) for an entire day of pile driving activity would accumulate energy from every impact strike. Fish that spent part of the day outside of this range due to avoidance or natural behavioral motivations would accumulate a lesser amount of energy, and may not reach the 187 or 183 dB re 1 $\mu Pa^2$sec SEL injury thresholds.

Fish occurring within the range to effect for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012; PFMC 2014b); these responses may resolve soon after pile driving ceases (NMFS 2014b). As noted in the PFMC (2014b) review discussed above, “some species of fishes, including Chinook salmon and Atlantic salmon (*Salmo salar*), have been shown to avoid continuous sounds (similar to vibratory pile driving) at frequencies below 30 Hz (infrasound), but not impulsive-type sounds (similar to those from impact pile driving) at frequencies above 100 Hz.” It is unlikely that minor, short-term changes in behavior, such as avoidance of the pile driving site, would preclude a fish from completing normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable.

Critical habitat PCEs for Puget Sound Chinook and Hood Canal summer-run chum that would be affected include estuarine areas, nearshore marine areas, and offshore marine areas. Pile driving would produce noise above the fish behavioral thresholds during vibratory pile driving and above the behavioral and injury thresholds during impact pile driving in the portion of the action area that contains critical habitat. However, effects to these PCEs would be discountable with implementation of a noise attenuation device during impact pile driving of steel piles, primarily installing piles using a vibratory pile driver.

Within the Hood Canal Subbasin, currently occupied riverine habitat is designated as Puget Sound steelhead critical habitat. Since DoD installations with current Integrated Natural Resources Management Plans (INRMPs) are exempt from critical habitat designation, no critical habitat is designated at NAVBASE Kitsap Bangor. Underwater noise generated during pile driving would not exceed established thresholds in critical habitats designated for Puget Sound steelhead.

Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment disturbance, limited potential impacts on aquatic vegetation and prey species relative to the overall availability of the resources in Hood Canal, conservative acoustic modeling assumptions, and the avoidance and minimization measures described above and in Appendix C, any potential effects to Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, or bull trout would be discountable. Any stressors that have the potential to affect critical habitat PCEs (e.g., disturbed sediments) would be highly localized to the immediate vicinity of in-water construction, and would not reach designated or proposed critical habitat. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

*ESA-Listed Hood Canal Rockfish*

Due to the similarity of life histories and habitat requirements between ESA-listed rockfish species, project-related impacts on these species are discussed by this species group rather than as individual species.

Threats to the recently listed bocaccio, yelloweye rockfish, and canary rockfish include areas of low DO, commercial and sport fisheries (notably, mortality associated with fishery bycatch), reduction of kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including by exotic species), derelict gear, climate change, species interactions (including predation and competition), diseases, and genetic changes (Palsson et al. 2009; Drake et al. 2010). LWI Alternative 2 would neither increase commercial or sport fisheries nor increase the presence of derelict gear, fish disease, or climate or genetic change; as a result, these limiting factors are not discussed further. The combination of these factors, in addition to rockfish life history traits, has contributed to declines in rockfish species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516).

<u>Rockfish Habitat Requirements</u>

Larval and juvenile rockfish are dependent on a variety of habitat factors, including suitable current patterns for larval transport to recruitment habitat (i.e., kelp, eelgrass), good water quality, and abundant food resources (Palsson et al. 2009). Vegetated habitats are important for food and refuge for young-of-the-year rockfish that are moving from pelagic to benthic rearing environment in their first year prior to entering more structured juvenile and sub-adult rocky habitat. Due to typically poor rockfish dispersal between basins, if habitat suitable for adult rockfish does not exist within a specific area, the abundance of adults would be low, as would the recruitment of juveniles into adjacent juvenile habitat. Since rockfish have complex life history patterns that use specific food and habitat requirements at each life history stage (larval, juvenile, adult), effects on the habitats used at each stage can affect the long-term presence of these species in local and adjacent waters.

<u>Currents</u>

Rockfish larvae are pelagic (live in the water column), with their movements influenced by prevailing currents within a given basin (Palsson et al. 2009). Even if adults are abundant and a strong class of larvae is produced in a given year, recruitment to suitable habitat can be limited because larval survival and settlement are dependent on a wide variety of unpredictable chance events, including current, climate, the abundance of predators, suitable recruitment habitat, and other chance events (Drake et al. 2010). Therefore, current patterns play a large role in the recruitment and distribution of rockfish larvae within and between water basins (Palsson et al. 2009).

As discussed in Section 3.1.2.2.2, small-scale and temporary (over periods of hours) changes in current direction and intensity of flow are anticipated as a result of construction activities and associated structures/vessels. However, the overall circulation pattern and velocities into the nearshore and marine deeper-water areas along the Bangor waterfront would be unaffected. Thus, in-water construction activity would have very limited and localized effects on circulation and currents, with limited effects on rockfish larval recruitment.

Water Quality

Palsson et al. (2009) indicate that rockfish may avoid waters with DO conditions below 2 mg/L and temperatures greater than 11$^{o}$C (Palsson et al. 2009). In 2002, 2003, 2004, and 2006, low-DO fish kills occurred in southern Hood Canal (Newton et al. 2007; Palsson et al. 2009). Rockfish, notably copper rockfish, experienced high mortality, with estimates of up to a quarter of all copper rockfish occurring at a southern Hood Canal marine preserve killed by these conditions (Palsson et al. 2009). However, within Hood Canal both the chronic and episodic events of low DO are typically limited to southern Hood Canal, with this pattern not as prevalent in northern Hood Canal waters (Newton et al. 2007), including off NAVBASE Kitsap Bangor. When conditions are not suitable at depths where they are normally present, rockfish tend to relocate to depths with more suitable conditions (Palsson et al. 2009; Drake et al. 2010), or are exposed to impacts from conditions such as low DO.

As noted for salmonids, the construction of LWI Alternative 2 would not degrade the existing DO concentrations in the project vicinity. Therefore, rockfish would not be subjected to any project-related increases in respiratory distress or altered distribution in response to DO reductions. The construction of LWI Alternative 2 would not result in water temperature increases. Therefore, rockfish would not experience impacts from elevated water temperatures as a result of LWI Alternative 2.

Limited information is available on the effects of turbidity on rockfish. However, effects would likely be similar to those described above for salmonids. Although construction activities would temporarily increase suspended solids, the levels would be insufficient to cause severe gill irritation or result in fish loss through mortality and conditions would return to background following the completion of in-water construction. If rockfish should encounter turbidity plumes with high levels of suspended sediment during construction activities, they would likely avoid these small plumes.

Habitat Alteration

Alteration of rockfish habitat can affect interrelated stressors identified by Palsson et al. (2009) and Drake et al. (2010), including reductions in the suitability of the habitat, and increased competition and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

*Suitable Habitat.* As noted above, juvenile (three to four months old) rockfish recruit to nearshore habitats that include algae-covered rocks or sandy areas with eelgrass or drift algae (Mitchell and Hunter 1970; Leaman 1976; Boehlert 1977; Shaffer et al. 1995; Johnson et al. 2003; Hayden-Spear 2006). While these studies indicate that the fish recruit to natural habitat encountered in offshore surface waters, other studies have found that post-larval juvenile rockfish also recruit to manmade, in-water structures (Emery et al. 2006; Love et al. 2005, 2006). Palsson et al. (2009) notes that structured habitat is "extremely" limited within Puget Sound waters. In addition, these types of structures also serve as habitat for sub-adult and adult lingcod, rockfish, and greenling (Love et al. 2002), which are potential predators of juvenile rockfish (see below). However, if they were to occur in the vicinity, it is unlikely that juvenile rockfish would recruit to the piles or in-water mesh as structured habitat during active in-water construction. No dredging or removal of existing high-relief, structured habitat potentially used by rockfish would occur during construction. However, reduction of nearshore marine vegetation at both LWI locations during construction could result in impacts to rockfish habitat in the project area.

*Predation.* Construction activity is not expected to increase recruitment of rockfish predators to the project area or create a physical environment that increases the susceptibility of rockfish to their predators. Barge movement, pile driving, decking and mesh installation, and other construction activities would create visual and auditory stimuli that most fish and fish predators would avoid. In addition, the three ESA-listed rockfish species generally prefer deeper-water habitats than occur within the construction footprint (other than potential larval recruitment to nearshore marine-vegetated habitats). Consequently, even in the absence of construction activity, their presence would be limited. Therefore, construction activities for LWI Alternative 2 are not expected to increase predation on juvenile or subadult rockfish.

*Competition.* Construction activities would not create an environment that would increase competition between rockfish and other marine fish species. In addition to the construction footprint occurring in waters shallower than rockfish generally prefer, these activities would create visual and auditory stimuli that most fish would avoid, including rockfish competitors. Therefore, construction activities for LWI Alternative 2 are not expected to increase competition between listed rockfish and their competitors.

*Prey Availability.* During construction, bottom disturbance would result in decreased prey availability for juvenile rockfish, although construction of pile-supported piers would not decrease plankton used as a primary food source for larval rockfish (Section 3.2.2.2.2). Some prey species for older, larger rockfish, such as crabs, surf perch, and forage fish, may experience a decrease in habitat availability during construction due to the disturbance of vegetated marine habitats. As a result, older age classes of rockfish, should they occur in the immediate project vicinity, may experience a similar decrease in this small fish prey base during construction activities and associated underwater noise during pile driving. However, upon completion of pile driving, underwater noise levels would return to levels consistent with current conditions and these prey species would no longer be expected to avoid the immediate project vicinity.

*Exotic Species.* Exotic organisms in Puget Sound waters, including nonindigenous marine vegetation that replace existing native marine vegetation (notably eelgrass or kelp), could pose a threat to rockfish survival (Palsson et al. 2009; Drake et al. 2010). Whether *Sargassum muticum*, a nonindigenous brown alga, affects rockfish settlement is not currently known (Palsson et al. 2009). However, Drake et al. (2010) suggest a possible threat to Hood Canal rockfish from *Ciona savignyi*, an invasive tunicate that has rapidly expanded its range in Hood Canal, and further note that elsewhere invasive tunicates have had widespread unspecified adverse effects on rocky-reef fishes, including rockfish.

Construction of the LWI would not increase the prevalence of exotic species in Hood Canal waters. None of the piles, decking, or fencing for the project would have occurred previously in other marine waters and, therefore, would not include attached exotic organisms. In addition, the vessels used during construction would comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species. Therefore, construction of the piers for LWI Alternative 2 is not anticipated to cause the introduction, spread, or increased prevalence of exotic organisms along the Bangor shoreline or the Hood Canal basin.

Underwater Noise

An additional project effect on rockfish that was not identified as a stressor in Drake et al. (2010), but is briefly mentioned in Palsson et al. (2009), is elevated levels of underwater noise. In a caged fish study investigating the effects of a seismic air gun on five species of rockfish (*Sebastes* spp.), Pearson et al. (1992) found that behaviors varied between species. In general, however, fish formed tighter schools and remained somewhat motionless.

Skalski et al. (1992) found the average rockfish catch for hook and line surveys decreased by 52 percent when the catches followed noise produced by a seismic air gun at the base of rockfish aggregations. Fathometer observations showed that the rockfish schools did not disperse but remained aggregated in schooling patterns similar to those prior to exposure to this noise. However, the aggregations did elevate themselves in the water column, away from the underwater noise source. Hastings and Popper (2005) indicate there are no reliable hearing data on rockfish, and it is not currently possible to predict their hearing capabilities based on morphology.

A more detailed description of effects on fish from anticipated underwater noise levels during construction is provided above for salmonids. Currently, underwater noise impact thresholds do not differentiate between fish species (Fisheries Hydroacoustic Working Group 2008). Although salmonids and rockfish have very different appearances and life histories, both groups use internal air bladders to maintain buoyancy.

As described above for salmonids, under LWI Alternative 2 if rockfish were to occur within the range to effect during pile driving or proofing, they would potentially be exposed to elevated underwater noise levels. Young-of-the-year rockfish weight-length relationships vary with species, habitat conditions, and food availability, but likely exceed 2 grams in weight upon reaching a length of approximately 1.8–2.4 inches (45–60 millimeters). Potential nearshore physical recruitment habitats would not be altered by underwater noise. This, combined with the intermittent occurrence of proofing for a maximum of just under

2 net hours per day during the first in-water work window, suggests that while physiological or behavioral impacts may occur, they would be limited in duration, intensity, and continuity.

Summary of Impacts and ESA-Listed Rockfish Determination

As noted in Sections 3.3.1.3.5, 3.3.1.3.6, and 3.3.1.3.7, bocaccio, yelloweye rockfish, and canary rockfish are rare in Hood Canal waters and are generally limited in Hood Canal by the lack of suitable habitat. Construction of the LWI piers would result in small-scale changes in current velocity and flow around in-water vessels. However, this effect would be too small and localized to alter existing nearshore currents or normal rockfish larval recruitment along the Bangor shoreline. Minor, temporary, and localized effects on water quality (notably small increases in turbidity) would occur, primarily during construction, but are not expected to decrease DO concentrations or increase water temperatures. Pile driving noise would exceed the fish behavioral threshold during vibratory pile driving and be above behavioral and injury thresholds during impact pile driving in the action area that contains critical habitat. However, effects to these PCEs would be discountable because pile driving would primarily use vibratory pile driving method, and would implement a soft-start approach.

Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment disturbance, limited potential impacts on aquatic vegetation and prey species relative to the overall availability of the resources in Hood Canal, and the avoidance and minimization measures described above and in Appendix C, any potential effects to bocaccio, canary rockfish, or yelloweye rockfish would be discountable. No population-level impacts for these species are anticipated to occur, and their continued survival would be unaffected. Any stressors that have the potential to affect critical habitat essential features (e.g., water quality and substrate conditions) would be localized to the immediate vicinity of in-water construction, and would not reach designated critical habitat. Underwater noise exceeding the behavioral threshold would reach critical habitat, but would only occur during active pile driving, and would not alter designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

*NON-ESA-LISTED SALMONIDS*

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. Utilizing in-water work windows would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, during pile driving due to their infrequent occurrence during the work window, and thereby resulting in limited exposure to elevated underwater noise.

*FORAGE FISH*

The only forage fish species with documented spawning habitat along the Bangor shoreline is the Pacific sand lance (Section 3.3.1.5). At the north LWI project site, Pacific sand lance spawning habitat has been documented along an estimated 1,000-foot (305-meter) length of the shoreline extending from the proposed abutment location southward (Figure 3.3–4). At the south LWI project site, spawning habitat has been documented along the shoreline approximately 500 feet (150 meters) north of the proposed abutment location, extending approximately

1,600 feet (488 meters) north. At each site, the excavation required for the abutment, placement of riprap, and abutment stair landings would occur below MHHW. At the north LWI project site these construction activities would impact documented sand lance spawning habitat. Sand lance spawning habitat in the footprint of the abutment would be lost, and the quality of sand lance spawning habitat in the immediate surrounding area affected by associated construction activities would be reduced relative to existing conditions. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC Northwest 2014).

Temporary increases of suspended solids during pile driving and other in-water construction activities would be expected, but due to strong nearshore currents and nearshore wind waves, the small amount of suspended fines that would settle out of the water column onto intertidal beaches would not be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat at the south LWI project site. However, since the north LWI project site occurs at the northern extent of this spawning habitat area, there could be some loss of function and suitability of this habitat during construction due to sediment resuspension and the temporary settling on spawning habitats, along with direct disturbance of these habitats from construction activities.

Forage fish that occur in the immediate project vicinity during in-water construction would be exposed to increased levels of turbidity. Based on recent nearshore beach seine data, forage fish, primarily surf smelt, have been shown to utilize the shoreline at the LWI project sites. Therefore, forage fish could be present and potentially affected by construction activities. During construction and post-construction reestablishment of disturbed vegetation and benthic communities, impacts on these communities may reduce available forage and refuge habitats for forage fish species. Due to behavioral responses, pre-spawn adult sand lance may reduce or avoid the use of this site during ongoing construction activity. Nighttime lighting associated with construction activities and daytime shadows cast from overwater structures and equipment would be expected to alter adult sand lance behavior at this site. Halvorsen et al. (2012b) determined that fish like sand lance that do not have swim bladders may be less susceptible to injury from simulated impact pile driving noise. In contrast, fish such as herring which migrate along the shoreline are considered "hearing specialists" and are able to detect frequencies up to at least 4,000 Hz. This heightened detection is enabled by a gas filled channel that connects the swimbladder to the otolith organs (Doksæter et al. 2009) but also makes them more susceptible to injury from impact pile driving. Nevertheless, because forage fish are expected to largely avoid the immediate vicinity of in-water construction, potential impacts to forage fish are expected to be limited to minor behavioral disturbance.

*OTHER MARINE FISH SPECIES*

Marine fish species occurring near the project area share the same habitats as salmonids and, with a few exceptions, would experience similar project-related impacts from the construction of LWI Alternative 2. As described above, construction of LWI Alternative 2 would not violate water or sediment quality standards (SQS) in the project area.

Project impacts on physical habitat and barriers during construction would include an increase in the number of barges and activities in the vicinity of intertidal and subtidal habitats. However, non-salmonids and forage fish occurring along the Bangor waterfront generally do not exhibit similar shoreline migrations (Hart 1973; Wydoski and Whitney 2003). Shiner perch is one of the most abundant other marine fish species in the project area and shows the greatest amount of migration near the Bangor shoreline. However, their migration is not along the shoreline but between shallow nearshore waters in the spring to bear their young and deeper offshore waters to overwinter (Hart 1973). During summer months when female shiner perch enter the shallows to bear their young, this species can be abundant at both the south and north LWI project sites (SAIC 2006; Bhuthimethee et al. 2009). However, when water temperature begins to cool in the fall, they are relatively absent at both locations. Since the majority of the construction would occur in cool water temperatures when this species is relatively absent, and because the piers under construction would be oriented parallel to their migration pathway, construction of this alternative would have only a minor impact on the movement of this species.

Benthic habitats used for marine fish foraging and rearing could be affected by construction activities (Section 3.2.2.2.2). Similar to salmonids, many non-salmonid fish species use forage fish as a food resource. As a result, any alteration in forage fish use of the site would reduce the local food resources of some non-salmonid fish species occurring in the area. Marine vegetation communities may also be affected during construction of LWI Alternative 2 (Section 3.2.2.2.2). Other marine fish species that have been found to frequent these marine vegetation habitats along the Bangor shoreline include shiner perch, gunnels, pricklebacks, sticklebacks, flatfish, and sculpin (SAIC 2006; Bhuthimethee et al. 2009). Construction impacts on these habitats could result in a corresponding loss of productivity in benthic organisms that use these habitats for foraging, refuge, and reproduction (Section 3.2.2.2.2) and a subsequent loss in available benthic food resources for marine fish species. However, these impacts are expected to limited in scope and intensity.

The in-water work window would be observed to protect ESA-listed salmonids from elevated underwater noise during pile driving. However, some of the most abundant non-salmonid or forage fish species captured in these waters, including juvenile and adult shiner perch, juvenile English sole, gunnels, pricklebacks, sticklebacks, and sculpin (SAIC 2006) may also occur during in-water work periods. Some fish may avoid the area, particularly closer to the location of in-water work, or alter their normal behavior while in this area. However, studies have shown that some fish species may habituate to underwater noise (Feist 1991; Feist et al. 1992; Ruggerone et al. 2008). Impacts from elevated underwater noise during pile driving would occur only during the in-water work window (July 15 to January 15). Upon completion of the pile driving effort, underwater noise would return to pre-construction levels.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

The primary impacts on marine fish from operation of LWI Alternative 2 would include an increase of physical barriers in the nearshore environment, alteration of nearshore habitats including some reduction in natural refugia, some reduction in prey availability, potential reduction in the forage fish community, and a decrease in nearshore aquatic vegetation. The following sections describe how each of these factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during operation of LWI Alternative 2.

Maintenance of LWI Alternative 2 would include routine inspections, cleaning, repair, and replacement of facility components (except pile replacement) as required. Measures would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect marine fish.

*ESSENTIAL FISH HABITAT*

EFH mostly would experience project-related impacts from operation of LWI Alternative 2 similar to those described below for salmonids; operation of LWI Alternative 2 would maintain water and sediment quality in the project area (Section 3.1.2.2.2). The EFHA provides a more comprehensive analysis of the EFH analysis as required by the MSA.

Long-term impacts on physical habitat and barriers would include an increase in overwater and in-water structures. Shading of marine vegetation and benthic habitats would be expected to result in a corresponding loss in EFH suitability and productivity (Section 3.2.2.2.2). Nearshore habitats would experience an increase in artificial lighting potentially reducing the quality and function of these habitats for nearshore fish that utilize these habitats for refuge, foraging, and migration. However, over-water lighting would be used very infrequently, during security responses only. While some EFH fish species (e.g., starry flounder and English sole) would experience a reduction in flat benthic habitat, others (e.g., greenling and cabezon) would experience an increase in high-relief habitat (e.g., vertical piles) more suitable for their life history. The addition of in-water structures to nearshore habitats utilized as migration corridors could alter this habitat such that it would represent a long-term barrier to juvenile salmonids. Groundfish species occurring along the Bangor waterfront do not display migration patterns consistent with salmonids and coastal pelagic species and, therefore, would not experience a migration barrier effect due to habitat alteration. However, due to the impacts on nearshore habitats utilized by all three species categories of EFH, potentially reducing habitat suitability and productivity, a determination was made that operation of the LWI under Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

*THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN*

*ESA-Listed Hood Canal Salmonids*

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Operation of the LWI under Alternative 2 would have little or no impact on localized temperature, salinity, DO, or turbidity (Section 3.1.2.2.2). Waterfront vessel activity would not be expected to increase substantially relative to existing conditions. In addition, BMPs implemented to minimize the degradation of water and sediment quality would be consistent with existing practices along the Bangor waterfront. Although some of the materials used for the LWI and PSBs would include galvanized metal, zinc loading in stormwater runoff is not expected to affect water quality at the project site as use of this galvanized metal is limited and the majority of other surfaces would consist of inert materials (Section 3.1.2.2.2). The in-water mesh is not composed of any materials that have the potential to degrade water quality along the Bangor shoreline.

Operation of LWI Alternative 2 would implement BMPs to minimize spill risks (Section 3.1.1.2.3). Operation of LWI Alternative 2 would not increase the risk of accidental spills because, other than minor small boat activities, project operations would not require the use of solvents, or other contaminants. No vehicular traffic would use the LWI structures and its surfaces would not generate pollution. Therefore, stormwater runoff from the LWI structures would not require treatment and could discharge directly into Hood Canal.

Changes in sediment grain size would only be anticipated in the immediate vicinity of each LWI structure, with little or no change in sediment characteristics beyond the footprint. Because sediments within the project area are considered uncontaminated, the small-scale changes in local sediment accretion and erosion during the operation of LWI Alternative 2 would not degrade existing conditions.

Physical Habitat and Barriers

Physical habitat and barriers are as described above under *Salmonid Marine Habitat Conditions*. Although numerous studies, summary reports, and white papers have investigated the effects of overwater structures on salmonid behavior, few have investigated the effects of fixed in-water mesh on these same species. Net pen rearing of juvenile salmonids uses variable mesh dimensions depending on the size of fish being reared. Mesh dimensions used for this industry, and the enclosures for field investigations of juvenile salmon, range from to 0.125 to 2 inches (0.32 to 5 centimeters) (Heard and Martin 1979; Mighell 1981; Zadina and Haddix 1990; Thrower et al. 1998). However, the mesh size of the in-water mesh would be larger than that used for captive rearing.

Regarding the potential barrier effect of the proposed LWI mesh, two studies in particular investigated juvenile fish response to various “trash rack” bar spacings in closed flume systems that were designed to simulate trash racks on fish passage structures for dams. Reading (1982) conducted observations of juvenile Chinook salmon (fork length of 35 to 75 millimeters [1.4 to 3.0 inches]) and American shad (fork length of 35 to 78 millimeters [1.4 to 3.1 inches]) behavior in a flume system when encountering various “trashrack bar spacings” of 7.6, 15.2, 22.9, and 30.5 centimeters (3, 6, 9, and 12 inches, respectively) at the Fish Screen Test Facility in Hood, California. In addition, this study investigated the effects of lighting and instream flow on the behavior of these two species. Reading (1982) concluded that channel velocity is the most important factor for juvenile Chinook salmon passage through trash racks, with no significant differences in salmon passage detected at the various bar spacings. In addition, salmon passage was found to be greater at night than during daylight hours. For American shad, Reading (1982) found that bar spacings less than 22.8 centimeters (9 inches) significantly reduced the passage of young American shad.

In a closed flume system, Hanson and Li (1983) examined the behavior of young-of-the-year Chinook salmon (mean fork length of 45.2 millimeters [1.8 inches]) when encountering in-water structures, in this case represented by bars separated at various distances (5.1, 7.6, 15.2, 22.9, and 30.5 centimeters [2, 3, 6, 9, and 12 inches, respectively]). Their findings indicated that bar spacings of less than 15.2 centimeters (6 inches) altered the behavior of the juvenile Chinook, whereas spacings of 15.2 centimeters and greater did not alter their behavior. Bar spacings of 5.1 and 7.6 centimeters resulted in reduced juvenile Chinook salmon transit time, with these juveniles "backing through" the bars, potentially subjecting themselves to elevated predation. The predation assumption is based on observations at the John E. Skinner Delta Fish Protective Facility, Tracy, California (Sacramento Bay Delta region) where a number of fish species frequently change their orientation prior to entering the "trash rack," resulting in entering tail first. Predation by yearling and adult striped bass on other fish species at the "trash rack" was extensive. The author's conclusions were that interbar spacings greater than 15 centimeters would not alter juvenile salmon transit times and should minimize predation rates of juvenile Chinook relative to predation rates that would occur with smaller bar spacings. Although these studies were conducted in closed systems and used bars rather than mesh, they suggest that an in-water mesh, with openings at least 15.2 centimeters, would allow for the passage of juvenile salmon up to 75 millimeters (3 inches) in length with little or no delay in their migration. However, it is likely that some fish greater than 75 millimeters in length would experience a behavioral response upon encountering an in-water mesh.

As indicated by larger 9-inch (23-centimeter) shad, passage by larger fish through a potential barrier was significantly reduced (Reading 1982). Based on this observation, it is likely that larger juvenile salmonid would hesitate prior to migrating through the structure, whereas others may not migrate through the structure, but would instead migrate around the most seaward point. Should juvenile salmonids during their nearshore migration concentrate either behind the mesh or around the seaward ends of either LWI, they have the potential to be exposed to increased predation by year-round occurring marine mammals and birds. Of greatest potential impact is that a delay in migration rate or alteration of the migration route may have the potential to affect survivability, as it could increase potential predation on nearshore-migrating juvenile salmonids. Any debris and/or fouling that collected on the mesh (e.g., floating marine vegetation, mussels, and barnacles) would reduce the effective size of the mesh, thereby increasing its influence as a barrier. To minimize this impact on juvenile salmonids, the Navy would, at a minimum, annually clean the mesh of floating debris and fouling organisms at the end of the standard work window, prior to the peak out-migration of juvenile salmonids. Although some portion of the juvenile salmonids that depend on nearshore habitats during their out-migration may migrate through the in-water mesh, particularly the smaller salmonids, many juvenile salmonids would potentially migrate along the mesh, toward deeper waters, and around the offshore end of each LWI mesh structure. Migrating around the structure would increase the length of their migration, requiring them to leave preferred nearshore habitats while potentially subjecting them to increased predation relative to existing conditions.

Because most species of adult salmonids are less dependent on nearshore habitats and also have much greater mobility, adults of these species would not experience the same barrier effects as nearshore-dependent juvenile salmonids as a result of the nearshore structures. However, due to their larger size, should they encounter these structures, they would be required to migrate around the entire structure, although this is expected to cause little or no delay in their overall movements. Due to the year-round occurrence of marine mammals at

NAVBASE Kitsap Bangor, some predation of adult salmonids may occur in the vicinity of the mesh if these fish congregate behind or become concentrated around the seaward ends of each LWI during their nearshore migration toward spawning streams.

Independent of the in-water mesh, there is some disagreement in the scientific literature regarding the scale and possible impacts of piles and overwater structures on juvenile salmonids when encountering these structures during shoreline migration and habitat use (Simenstad et al. 1999; Weitkamp et al. 2000; NMFS 2004). Some studies indicate that structures (such as the in-water piles and overhead decking of LWI Alternative 2) can represent barriers to shoreline-dependent juvenile salmon migrating along the Bangor shoreline (Salo et al. 1980; Simenstad et al. 1999; Nightingale and Simenstad 2001a; Southard et al. 2006). Juvenile salmonids have been shown to avoid crossing the shade/light line created by an overhead pier/dock (summarized in Simenstad et al. 1999; Nightingale and Simenstad 2001a; Southard et al. 2006). However, the height-over-water of a structure, such as a pier or trestle, has been noted as the most important design aspect for allowing increased light availability under a structure (Burdick and Short 1999). The design of the pier leading from the on-land support facility across the nearshore habitat and eventually connecting to the PSBs would be constructed with a deck height of approximately 17 feet (5 meters) above MLLW. The decking would include light-penetrating grating that would minimize the shade cast by the LWI structures. Therefore, only a narrow band of nearshore shade, with a reduced contrast due to grating, would be cast from the structures across the juvenile salmonid and forage fish migratory pathway. This effect would be greatest at higher tides when the height-over-water would range from 1 to 5 feet (0.3 to 1.5 meters). The shade cast from the structure alone would be minor, but combined with the effect of the in-water mesh would potentially result in behavioral responses by juvenile salmonids. Effects could include delays in seaward migration and likely increases in the prevalence of juvenile salmonids migrating around the end of the structure into deeper, offshore waters, with the potential for exposure to higher predation rates than would occur along normal nearshore pathways.

The LWI Alternative 2 abutments would occur above the normal tidal range, in supratidal habitats. Hughes (2015) indicates that these habitats are used by salmonids and forage fish for migration. During extreme high tides, which occur infrequently and for short periods, the presence of the two abutments would represent a migration barrier for those fish migrating in very shallow waters. Additionally, the presence of the two concrete abutments would result in a long-term change in physical habitat.

A potential migration barrier to juvenile salmon migration at night is artificial lighting. Marine fisheries utilize lights, and light intensity is managed, to attract and harvest a variety of marine species (Marchesan et al. 2005). Becker et al. (2013) demonstrated that both predator and prey species of fish can be attracted to light, although not all species demonstrate this behavior. Studies have also shown that salmonids have been attracted toward and congregate around structures with artificial lighting, thereby potentially delaying their migration (Prinslow et al. 1980; Simenstad et al. 1999; Nightingale and Simenstad 2001a). The active industrial Bangor waterfront supports eight major piers and docks, averaging nearly 150,000 square feet (3.4 acres [1.4 hectares]) each. The largest piers at the Bangor waterfront are outfitted with more than 100 industrial overhead, security, doorway, and walkway lights. The LWI project would use over-water lighting very infrequently, during security responses only. Therefore, there would be little or no risk of attraction of salmonids or resultant alternation in behavior, migration, or increased risk of predation.

Biological Habitat

*Prey Availability.* LWI Alternative 2 would result in the increase of shaded marine habitat (Section 3.2.2.2.2). As addressed for Marine Vegetation, impacts on eelgrass habitats would be mitigated as described in the Mitigation Action Plan (Appendix C, Section 6.0). In addition to construction-related effects on eelgrass, shading would result in some additional long-term impacts or loss of macroalgae habitat. In addition to the long-term occurrence of the piles supporting the LWI piers, the presence of the steel plate anchoring for the mesh would permanently reduce the productivity of benthic habitats, and therefore foraging habitats for marine fish at both LWI locations (Section 3.2.2.2.2). The loss or reduction of algae would result in a corresponding decrease in the productivity of epiphytes and benthic invertebrates that use this habitat. Nearshore-occurring fish also would be expected to experience some loss in the availability of benthic prey due to the presence of these structures (Section 3.2.2.2.2). The presence of the pile-supported piers and in-water mesh could result in minor impacts on forage fish migration, prey base, and Pacific sand lance spawning at the north LWI project site.

*Aquatic Vegetation.* The presence of LWI Alternative 2 would reduce eelgrass habitats available to juvenile salmon migrating along the Bangor shoreline, but successful mitigation is anticipated to offset this loss. Shading impacts on aquatic vegetation, including eelgrass, would be minimized due to the use of grating for the LWI decking. Steel plates and piles would permanently eliminate 0.076 acre (0.031 hectare) of marine vegetation including 0.024 acre (0.01 hectare) of eelgrass. The compensatory aquatic mitigation action (described in Appendix C, Section 6.0) would compensate for these impacts.

Underwater Noise

Operation of LWI Alternative 2 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. Little or no increase in underwater noise would occur from activities on the pier since no cranes, generators, compressors, or other machinery would be required to operate on these structures. As a result, operation of LWI Alternative 2 would not raise background noise above the thresholds of injury or guideline for behavioral effects for ESA-listed fish.

Summary of Impacts and ESA-Listed Salmonids Determination

Operation of LWI Alternative 2 may result in impacts on physical barriers, refugia, prey availability, forage fish community, and aquatic vegetation, which are considered important for ESA-listed salmonids. Based on the low likelihood of occurrence in the project area, no population-level effects to Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum, or bull trout are anticipated.

Nevertheless, operation of LWI Alternative 2 may affect Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, and bull trout. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats.

Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

*ESA-Listed Hood Canal Rockfish*

Rockfish Habitat Requirements

Currents

As discussed above for salmonids, due to the presence of the piles and in-water mesh structures, operation of the LWI under Alternative 2 would have only minor and local effects on water flow in the immediate vicinity of the piles and in-water mesh. In particular, there would be an increase in turbulent flow in the immediate vicinity of the piles and in-water mesh and a decreased flow immediately downstream (Section 3.1.2.2.2). However, these changes would be small scale and localized to the immediate vicinity of the in-water components of each pier structure. The overall flow of water in deeper water areas adjacent to the piers would not be affected by the structures. As a result, due to the limited and localized scale of project effects on currents, the operation of LWI Alternative 2 would not modify currents at a scale that would affect rockfish recruitment within northern Hood Canal waters.

Water Quality

As discussed above for salmonids, operation of the LWI under Alternative 2 would not impact existing DO levels in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. In addition, due to the general maintenance of existing flow conditions, LWI operations would not result in water temperature increases over existing conditions and would not elevate levels of suspended solids sufficient to degrade water quality or cause impacts on these species (Section 3.1.1.1.2).

Habitat Alteration

As addressed below, rockfish habitat alteration can cause three interrelated stressors identified by Drake et al. (2010) and Palsson et al. (2009), associated with loss of suitable habitat, predation, and competition. Limited or altered habitat could also affect prey availability and the presence of exotic species.

*Suitable Habitat.* Some loss of marine vegetation, potentially used for juvenile rockfish recruitment, would occur due to overwater shading from the proposed structures. At some tidal elevations, shade-related effects would occur due to the low overwater height of the piers (17 feet [5 meters] above MLLW). Operations would not be expected to inhibit kelp growth because no attached, canopy-forming kelp beds occur along the Bangor waterfront (Section 3.2.1.1.2).

LWI Alternative 2 would result in the placement of up to 136 permanent piles to support both piers, attached docks, and gangways plus 120 temporary piles. These piles could serve as post-larval juvenile rockfish recruitment habitat. In addition, the presence of the in-water meshed structures would introduce structured habitat where it currently does not occur. In Hood Canal, suitable structured habitat for rockfish recruitment is very limited (PSAT 2007a; Palsson et al. 2009), with existing marine reserves accounting for almost 20 percent of the available nearshore rocky habitat (PSAT 2007a). Suitable habitat is limited between NAVBASE Kitsap Bangor and the Toandos Peninsula. WDFW conducted 24 trawls in this vicinity and did not capture any of the three ESA-listed rockfish (Palsson 2009, personal communication). The lack of suitable recruitment habitat within Hood Canal largely contributes to the patchy and limited distribution and abundance of rockfish in Hood Canal.

Although the in-water mesh may serve as potential structured habitat, the fence would be cleaned of fouling debris at least annually, just prior to the peak juvenile salmonid out-migration. This cleaning may reduce the suitability of this structure for other, non-salmonid, fish species such as rockfish. Although there are substantial difficulties comparing the loss of marine vegetation to the addition of manmade structures as habitat for juvenile rockfish recruitment, it is likely that the loss of marine vegetation habitat is offset, to some degree, by the addition of structured habitat. Whether the change in habitat type would be a net benefit or detriment to rockfish is unknown.

*Predation.* The same piles and in-water mesh that could serve as a potential recruitment benefit to juvenile bocaccio, yelloweye rockfish, and canary rockfish could also serve as habitat for rockfish predators (e.g., lingcod, and larger sub-adult rockfish). Baskett et al. (2006) found that, prior to commercial fishing pressure, predation and competition primarily shaped the rockfish community structure. This was mostly due to rockfish intra-guild predation, including large adult rockfish preying on smaller rockfish members, as well as predation by lingcod. Beaudreau and Essington (2007, 2009) found that rockfish comprise 11 percent of adult lingcod diet by mass. These studies showed that in structured habitats protected from fishing (i.e., marine reserves), lingcod can limit the prevalence of rockfish through predation. The average size and abundance of lingcod in the existing NAVBASE Kitsap Bangor pier habitats is unknown, but the piers and in-water mesh associated with this alternative could result in increased predation on juvenile rockfish. To what extent the annual cleaning of this mesh would affect its suitability as recruitment habitat for structure-dependent species is unknown. Further, it is unknown if the benefit of these structures for suitable recruitment habitat would be equivalent to any potential loss of juvenile rockfish to predators.

*Competition.* Habitat modification due to the piers and in-water mesh of this alternative would result in a benthic-to-structure community shift and may create habitat that is more suitable for one species of rockfish compared to others. As noted above, juvenile rockfish can occur in shallow, nearshore waters over rocks with algae or in sandy areas with eelgrass or drift algae. The presence of the more structured habitat may promote competition with species that use these habitat types for recruitment and rearing. Whether the existing benthic habitat or the proposed structured habitat would be more beneficial to rockfish is unknown. Whether the annual cleaning of this mesh would result in the absence of juvenile rockfish is also unknown.

Palsson et al. (2009) note that, in the absence of fishing pressure, the more aggressive copper and quillback rockfish species appear to limit the prevalence of brown rockfish. Both of these rockfish species appear to be more prevalent in Hood Canal waters than any of the three ESA-listed rockfish species and may out-compete other rockfish species for the limited structured habitat. Therefore, due to natural factors, including intra-guild competition, an increase in suitable structured habitat would not necessarily result in a corresponding increase of listed rockfish abundance in the project area.

*Prey Availability.* Since operation of LWI Alternative 2 would not decrease the local abundance or distribution of plankton along the Bangor shoreline (Section 3.2.2.2.2), larval bocaccio, yelloweye rockfish, and canary rockfish would not experience a decrease in food availability. The in-water structures would reduce the size and suitability of some habitats, notably marine vegetation used by forage fish and shiner perch (juvenile/sub-adult rockfish food resources). However, the piles and in-water mesh would provide structure used by other potential prey base species, including the invertebrate fouling community, crabs, juvenile rockfish, perches, sculpins, and greenling (Hueckel and Stayton 1982; Nightingale and Simenstad 2001a; Love et al. 2002). Whether the small local shift in community type would have a corresponding effect on rockfish is unknown.

Due to the construction and operation of the LWI structures under Alternative 2, the prey of benthic-obligate juvenile rockfish within the immediate project vicinity could decrease in abundance, whereas structure-dependent juvenile rockfish and their associated prey could increase. It is not known which of these effects would be greater. Therefore, a small, local change in the type of prey resources available would be likely, but with an unknown effect on total prey availability.

*Exotic Species.* Operation of the LWI under Alternative 2 would not introduce exotic species from foreign water bodies or increase the prevalence of existing exotic species in Hood Canal waters. Further, operation of the LWI would not create chronic disturbances that would facilitate colonization by non-indigenous species. Therefore, operation of the LWI under Alternative 2 is not anticipated to facilitate the spread or prevalence of exotic organisms along the Bangor shoreline or the Hood Canal basin.

Underwater Noise

As discussed above for salmonids, operation of LWI Alternative 2 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. Further, little or no increase in underwater noise would occur from activities on the pier as no cranes, generators, compressors, or other machinery would be required to operate on these structures. As a result, operational noise would not rise above background noise levels and exceed the thresholds of injury or guideline for behavioral disturbance for ESA-listed fish.

Summary of Impacts and ESA-Listed Rockfish Determination

As detailed in the sections above, operation of LWI Alternative 2 would not result in adverse impacts on water quality (Section 3.1.2.2.2) or increase the prevalence of exotic species. Bocaccio, yelloweye rockfish, and canary rockfish are extremely rare in Hood Canal waters. The structure-supporting piles and in-water mesh and anchoring systems would convert localized areas of existing soft-bottom benthic habitat to in-water hard substrate structures that could affect local prey availability, as well as the potential to increase recruitment of juvenile bocaccio, yelloweye rockfish, canary rockfish, and rockfish competitors and predators. However, based on the low likelihood of occurrence in the project area, these effects would be discountable, and no population-level impacts are anticipated.

Nevertheless, operation of LWI Alternative 2 may affect bocaccio, canary rockfish, and yelloweye rockfish. No operational stressors associated with the proposed project are anticipated in designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

*NON-ESA-LISTED SALMONIDS*

Impacts described above for ESA-listed salmonids due to operation of LWI Alternative 2 would be similar for other salmonids potentially occurring in the project area.

*FORAGE FISH*

Operation of LWI Alternative 2 would have little or no impact on surf smelt or Pacific herring spawning habitats or their reproductive success because no documented surf smelt or Pacific herring spawning grounds occur along the 4.3-mile (7-kilometer) long Bangor waterfront (Penttila 1997; Stout et al. 2001; WDFW 2013; NAVFAC Northwest 2014). However, at the north LWI project site, Pacific sand lance spawning habitat has been documented from the proposed abutment location southward (Figure 3.3–4, Section 3.3.1.5.3). At the south LWI project site, spawning habitat has been documented approximately 500 feet (150 meters) north of the proposed abutment location. Sand lance spawning habitat in the footprint of the north LWI project site abutment and abutment stair landings would be lost. The quality of sand lance spawning habitat in the immediate surrounding area of these structures would be reduced relative to existing conditions. The loss and potential reduction in quality of sand lance spawning habitat would not occur at a scale that would affect the overall population of sand lance in Hood Canal, or their overall availability as a food source to predators dependent on these populations. However, should sand lance no longer occur in the immediate vicinity of the project site due to the new structures, they would also no longer be available to predators in the immediate project vicinity. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC Northwest 2014). If ongoing studies find that this site is being utilized by forage fish, similar impacts would be experienced as described for the north LWI project site.

Hughes (2015) indicates that the supratidal region is used by forage fish for migration, foraging, refuge, and spawning. These areas are inundated infrequently for short periods. The LWI Alternative 2 abutments would extend from above the normal tidal range into supratidal habitats. Within the supratidal abutment footprints and immediate surrounding areas, these structures would be expected to result in the infrequent loss of function of these habitats with respect to forage fish migration, foraging, refuge, and spawning.

Although the presence of the in-water mesh may not be as substantial a barrier to larval and juvenile forage fish as to larger juvenile salmonids, the presence of in-water structures and the impacts affecting juvenile and adult forage fish behavior would be similar to those described above for salmonids. The close proximity of these structures to documented Pacific sand lance spawning habitat indicates that, depending on whether adults spawn upstream or downstream of a given structure, either adults migrating toward or larvae emerging from these locations would have to navigate through or around the barriers.

In a review of sand lance biology, Robards et al. (1999) found that some studies indicate sand lance behavior is strongly tied to food availability, water temperatures, and light intensity, including artificial nighttime lighting. The use of nighttime artificial lights along the pier is expected to be infrequent, with little or no risk of attracting forage fish, altering behavior (including migration), or increasing the risk of predation. Nearshore vessel activity associated with the new structure would not increase over existing conditions. Therefore, underwater noise associated with operation of LWI Alternative 2 would not increase above existing ambient levels. Additionally, operation of LWI Alternative 2 would not result in changes in the plankton community (the primary forage fish resource), and this resource would continue to occur in the project vicinity (Section 3.2.2.2.2). However, as discussed above for salmonids, operation of LWI Alternative 2 would adversely impact and reduce the function of nearshore benthic habitats. In addition, the presence of the piles, in-water mesh, and daytime shadows could result in a physical barrier effect on nearshore migrating fish, including forage fish.

*OTHER MARINE FISH SPECIES*

With a few exceptions, marine fish species that are found near the project area share the same habitats as salmonids and would experience project-related impacts from operation of LWI Alternative 2 similar to those described for salmonids, forage fish, and rockfish. As summarized above for these species, operation of LWI Alternative 2 would maintain water and sediment quality in the project area (Sections 3.1.2.2.2).

Project impacts on the physical habitat and barriers would include an increase in nearshore structures in intertidal and subtidal habitats. The presence of these structures would result in localized decreases in currents around the piles. The shading of marine vegetation and benthic habitats would be expected to result in a corresponding loss of productivity in benthic organisms that use these habitats for forage, refuge, and reproduction, thereby resulting in a loss of benthic food resources. While some fish species (e.g., flatfish including starry flounder and English sole) would experience a reduction in flat benthic habitat suitable for their life history, others (e.g., pile perch and greenling) would experience an increase in habitat suitable for their life history (Hart 1973). The loss of some nearshore vegetated habitat in the immediate vicinity of both LWI structures would decrease habitat value for female shiner perch bearing their young. However, since this habitat conversion would be a relatively small percentage of the total Bangor shoreline, the conversion would not result in a significant overall reduction of fish populations occurring along the Bangor shoreline.

As discussed for construction, the presence of nearshore structures would represent a migration barrier to salmonids and forage fish. However, few other species occurring along the Bangor waterfront exhibit shoreline migration patterns similar to those of salmonids (Hart 1973). For example, shiner perch, the most abundant non-salmonid or forage fish captured in these waters (SAIC 2006; Bhuthimethee et al. 2009), overwinter in deeper offshore waters and migrate into nearshore waters in the spring to bear their young (Hart 1973).

#### 3.3.2.2.3. LWI Alternative 3: PSB Modifications (Preferred)

CONSTRUCTION OF LWI ALTERNATIVE 3

As described below in a comparative manner to the detailed analysis provided for Alternative 2, there are some differences in construction-related impacts between LWI Alternatives 2 and 3, including no in-water pile driving for Alternative 3, smaller overwater coverage, reduced impact on nearshore benthic and marine vegetated habitats, no in-water mesh, and a shorter duration of in-water construction.

*Essential Fish Habitat*

Impacts on EFH from the construction of LWI Alternative 3 would be similar in type, but smaller in extent and duration, than those described for LWI Alternative 2 (see detailed discussions in Sections 3.1.2 and 3.2.2). Differences include no in-water pile driving, and a slightly smaller area of potential construction impacts on water quality, seafloor, and marine vegetation for LWI Alternative 3 than for Alternative 2 (12.7 versus 13.1 acres [5.2 versus 5.3 hectares]). These differences would decrease in scale the project-related impacts on EFH. With the exception of no in-water pile driving noise, LWI Alternative 3 would affect EFH in a similar manner, but at a smaller scale, than described for LWI Alternative 2. LWI Alternative 3 construction activities would not adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH, as detailed below.

*Threatened and Endangered Marine Species and Species of Concern*

*ESA-Listed Hood Canal Salmonids*

Salmonid Marine Habitat Conditions

Impacts on marine habitats used by ESA-listed Hood Canal salmonids would be similar for all listed and non-ESA-listed salmonid species.

Water and Sediment Quality

Construction-related impacts from LWI Alternative 3 on water and sediment quality would be smaller in scale and shorter in duration than those for LWI Alternative 2 (Sections 3.1.2.2.2 and 3.1.2.2.3). Construction of LWI Alternative 3 would involve no in-water driving of piles and fewer in-water work days, as detailed above. Alternative 3 would impact a smaller footprint of benthic habitats (up to 12.7 acre [5.2 hectare] vs. 13.1 acre [5.3 hectare]) and though an increase in turbidity in the immediate project vicinity is expected Alternative 3 is not anticipated to violate water or sediment quality standards. In addition, the fish window precludes in-water construction occurring at a time when juvenile salmonids would be prevalent. Therefore, project-related effects on nearshore water and sediment quality used by salmonids under LWI Alternative 3 would be similar in type, but much smaller in scale, to those effects described for Alternative 2.

Physical Habitat and Barriers

Construction of the abutment would be the same as for Alternative 2, and therefore would not represent a substantial migration barrier to juvenile salmonids. Compared to LWI Alternative 2, construction activities for Alternative 3 would require no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during constructions, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats, perpendicular to the shoreline. The observation post piles (12 at each location) would be located in the upper intertidal and driven in the dry during low tides. A coffer dam would be utilized to minimize project impacts. The coffer dam would be 140-feet (43 meters) long for the north LWI and 160-feet (49 meters) long for the north LWI stairs. Along the south side, the coffer dam would be190-feet (58 meters) long for the LWI and 160-feet long for the LWI south stairs.

Construction activities that could constitute a behavioral disturbance barrier to salmonids, as well as other species, include vessel shading, barge anchoring and spud/anchor dragging, underwater noise, and turbidity plumes. Because it would not include the pile-supported pier or in-water mesh, LWI Alternative 3 would have fewer of these types of impacts and the associated barrier effect than Alternative 2. During installation of LWI Alternative 3, the construction equipment and activity occurring in habitats that serve as migratory pathways for nearshore fish species could affect their movement patterns and potentially represent a partial physical or visual barrier to migration.

Lighting would originate from construction barges, vessels, and equipment during the 1-year construction period. The presence of artificial light during construction could increase nighttime predation of fish by visual predators. Compared to LWI Alternative 2, nighttime lighting from LWI Alternative 3 construction activities would be smaller in scale and duration, and is expected to have a correspondingly lower potential effect on fish that would occur during in-water work.

Biological Habitat

Due to fewer in-water and overwater structures required for LWI Alternative 3, and the smaller overall project footprint, impacts on marine vegetation and benthic habitats and the vertebrate and invertebrate prey resources that utilize these habitats would be much smaller than for LWI Alternative 2 (Section 3.2.2.2.3). Because LWI Alternative 3 would require a shorter in-water construction duration than Alternative 2 and no in-water pile driving, the nearshore biological habitats used by salmonids would be exposed to much lower levels of underwater noise and for a shorter duration. Larger juvenile salmonids (e.g., Chinook and coho) and adult salmonids migrate further offshore in the neritic zone and are generally less dependent on nearshore biological habitats. However, should they utilize these resources in the project footprint during construction, these salmonids may experience temporary loss of available biological resources, including benthic prey. Similar to LWI Alternative 2, the project materials used for LWI Alternative 3 are not expected to introduce or increase the prevalence of exotic species to Hood Canal waters. Therefore, construction of LWI Alternative 3 would impact nearshore biological habitats utilized by salmonids, but impacts would be reduced for Alternative 3 compared to Alternative 2.

Underwater Noise

For underwater noise effects on fish, the greatest difference between LWI alternatives would be that Alternative 3 would involve no in-water pile driving. Although the general project area is the same, underwater noise during construction of LWI Alternative 3 would be limited to that generated by support vessels, small boat traffic, and barge-mounted equipment, such as generators. Vessel activity required for construction would result in temporary noise and visual disturbance in the immediate vicinity of some of these vessels.

Summary of Impacts and ESA-Listed Salmonid Determination

Construction-related impacts of LWI Alternative 3 on NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be much smaller in duration and scale than those described for LWI Alternative 2. Compared to LWI Alternative 2, construction activities for Alternative 3 would require no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats. No element of LWI Alternative 3 construction would extend beyond NAVBASE Kitsap Bangor boundaries and reach proposed or designated critical habitat waters. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

*ESA-Listed Hood Canal Rockfish*

Impacts on currents, water quality, and habitats during construction of LWI Alternative 3 would be considerably smaller than those described for LWI Alternative 2. The greatest differences between the alternatives would be no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no in-water mesh installed for Alternative 3.

Nevertheless, construction of LWI Alternative 3 may affect bocaccio, canary rockfish, and yelloweye rockfish. Any stressors that have the potential to affect critical habitat essential features (e.g., water quality, substrate conditions) would be localized to the immediate vicinity of in-water construction, and would not reach designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

*NON-ESA-LISTED SALMONIDS*

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. The use of in-water work windows would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during the work window. Compared to LWI Alternative 2, construction activities for Alternative 3 would require no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats. Therefore, impacts to non-ESA-listed salmonids would be minimal.

*FORAGE FISH*

Similar to Alternative 2, forage fish would likely experience some reduction in nearshore habitat availability during LWI Alternative 3 construction due to temporary increases in turbidity, nighttime lighting, and daytime shadows cast from overwater structures and equipment. This could potentially include sand lance avoiding intertidal spawning habitat in the vicinity of the north LWI project site. Construction-related impacts to forage fish spawning habitats would be similar to those of Alternative 2, but with the addition of impacts from installation of the observation post piles. At the north LWI project site, sand lance spawning habitat in the footprint of the abutment and observation post piles would be lost, and the quality of sand lance spawning habitat in the immediate surrounding area affected by associated construction activities would be reduced compared to existing conditions. The loss and potential reduction in quality of sand lance spawning habitat would not occur at a scale that would affect the overall population of sand lance in Hood Canal, or their availability as a food source to predators dependent on these populations. However, should sand lance no longer occur in the immediate vicinity of the project site due to the new structures, they would also no longer be available to predators in the immediate project vicinity. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC Northwest 2014). As described above for salmonids, LWI Alternative 3 construction would not require in-water pile driving and would be of a shorter duration than LWI Alternative 2. Therefore, impacts to forage fish would be minimal.

*OTHER MARINE FISH SPECIES*

Construction of LWI Alternative 3 would include no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats compared to construction of LWI Alternative 2. Although some of these reductions are substantial compared to LWI Alternative 2, the construction of LWI Alternative 3 would still affect nearshore habitats utilized by other marine fish species for foraging, refuge, and reproduction. Therefore, impacts to other marine fish species would be minimal.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 3

The primary impacts on marine fish from operation of LWI Alternative 3 would include an increase of physical structures in the nearshore environment, alteration of nearshore habitats including some reduction in natural refugia, potential reduction in prey availability/forage fish community, and potential decrease in nearshore aquatic vegetation. The following sections describe how each of these factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during operation of LWI Alternative 3.

Maintenance of LWI Alternative 3 would include routine inspections, cleaning, repair, and replacement of facility components (except pile replacement) as required. Measures would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect marine fish.

*ESSENTIAL FISH HABITAT*

Some operational impacts on EFH from the operation of LWI Alternative 3 would be similar to those described for salmonid EFH and other marine fish EFH for LWI Alternative 2. Operational impacts on water and sediment quality (Section 3.1.2.2.3) would be similar, and vessel activity would not differ measurably between the two alternatives. However, other operational impacts from LWI Alternative 3 would be much smaller than for LWI Alternative 2. The total overwater area would be smaller for LWI Alternative 3 than for Alternative 2 (0.12 vs. 0.4 acre [0.05 vs. 0.16 hectare]) (Section 3.2.2.2.3). Additional differences would include fewer in-water piles, less overwater shading of benthic and marine vegetated habitats, and no in-water mesh for LWI Alternative 3. However, operational impacts of Alternative 3 would include grounding of the PSBs and buoys during low tide in shallow water EFH (Section 3.2.2.2.3). Operation of LWI Alternative 3 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

*THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN*

*ESA-Listed Hood Canal Salmonids*

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Long-term impacts on water and sediment quality from operation of LWI Alternative 3 would be similar to LWI Alternative 2 (Section 3.1.2.2.3), and would not violate water or sediment quality standards in habitats used by salmonids. In addition, BMPs implemented to minimize the degradation of water and sediment quality would be consistent with existing practices along the Bangor waterfront.

Physical Habitat and Barriers

With respect to potential physical barriers to fish movement in nearshore marine habitats, LWI Alternative 3 would have fewer in-water and overwater components and associated lighting than LWI Alternative 2. The most important difference between the alternatives regarding in-water barriers is that Alternative 3 would not include the in-water mesh structure perpendicular to the shoreline that would occur for Alternative 2. Under Alternative 3, the guard panels between the PSB pontoons would represent less of a barrier to fish movement in nearshore waters than the in-water mesh of Alternative 2. Alternative 3 would have far fewer in-water piles (24) than Alternative 2 (150). In addition, the overwater area associated with Alternative 3 (0.12 acre [0.05 hectare]), which includes nearshore PSBs and observation posts, would be much smaller than the overwater shading for Alternative 2 (0.34 acre [0.14 hectare]), which includes pile-supported piers and floating docks.

The PSBs are oriented such that they would occur in a line over nearshore habitats, would float in the top foot of water, and would cast minimal shadow, so the shade they would cast is not expected to represent a substantial in-water barrier to fish movement. From each of the floating PSBs, the metal grating (guard panels) would extend into the water less than 1 foot (30 centimeters) (Section 2.1.1.3.3). Salmonids encountering the floating PSBs in deeper water (e.g., depths greater than 8 to 10 feet [2.4 to 3.0 meters]) would not likely be affected by the presence of these structures, and would simply swim underneath the PSB and attached grating. However, smaller salmonids, notably fry, which encounter these structures in much shallower nearshore waters, may experience some combination of physical and/or visual barrier effects (Section 3.3.2.2.2). These fish would be expected to move toward slightly deeper water where they could more easily swim underneath the floating PSB units. Although there are few piles that would occur in the migratory pathway, and minimal lighting for the new structures, the year-round, semi-diurnal (twice daily) grounding of the PSBs in shallow waters could represent a partial barrier with respect to visual disturbance or avoidance of juvenile migration in these waters. However, the partial barrier would not differ greatly from other naturally occurring barriers encountered in the marine environment. For these reasons, the operation of LWI Alternative 3 could represent a partial nearshore barrier to fish movement, but it is not expected to have a measurable effect on the movement of fish in these habitats.

Biological Habitat

Because of a decrease in the number of piles, in-water and over-water structures, and total project footprint for LWI Alternative 3, the operational impacts on marine vegetation and benthic communities and their productivity would be smaller than those described for LWI Alternative 2 (Section 3.2.2.2.3). One operational aspect that would occur under Alternative 3 but not Alternative 2 would be the grounding of intertidal PSB units. Operation of the PSB segments would impact marine vegetation and benthic habitats in the intertidal zone where the PSB feet contact the bottom during low tide stages. In particular, the periodic (tidal-dependent) but repeated disturbance of the seafloor would affect the habitats in these disturbance zones. Over the long term, which would include extreme low tides, approximately 18 PSB units including 54 pontoons and three buoys would ground out in the intertidal zone. Five of these PSB units and one buoy would ground out at the north LWI and 13 PSB units and two buoys would ground out at the south LWI. It is estimated that approximately 2,594 square feet (241 square meters) of the intertidal zone would be disturbed over the long term (725 square feet [67 square meters] at the north LWI and 1,869 square feet [174 square meters] at the south LWI) (Section 2.1.1.3.3). Alternative 3 would relocate four existing PSB buoys and associated anchors at the North LWI project site, reducing the number of anchor legs and anchors for two of the four buoys. Three existing PSB buoys and associated anchors would be relocated and one new buoy and associated anchors would be added at the south LWI project site. Although the net effect would be a small decrease in the total number of PSB buoy anchors, the relocated buoys and anchors would be located in previously undisturbed areas, resulting in minor long-term impacts in those areas.

Predation

Operation of LWI Alternative 3 would increase the number of floating Port Security Barriers in the nearshore environment, including an increase in intertidal habitats. These floating structures have the potential to act as haulout sites for seals and sea lions, representing known predators on salmonids and other marine fish species. As documented by marine mammal surveys that commenced at Bangor Naval Base in 2008 (Section 3.4.1.1.3), the numbers of California and Steller sea lions hauling out on submarines at Delta Pier and Port Security

Barrier pontoons have increased without the addition of any new haulout sites. The majority of sea lions haul out on submarines rather than pontoons. Those sea lions that that have been detected on pontoons have been in close proximity to Delta Pier. The majority of the existing pontoons along the waterfront have never been used for hauling out by sea lions. Sea lions have not been detected hauling out elsewhere along the Bangor shoreline. Though it is possible that sea lions could use the additional pontoons installed under LWI Alternative 3 as haulout sites, marine mammal surveys have shown that the sea lions at Bangor appear to prefer to be in close proximity to the submarines at Delta Pier. Under current conditions, sea lions can readily access nearshore areas from existing Delta Pier haulout sites. As a result, the presence of the intertidal LWI pontoons is unlikely to increase the presence of sea lions at Bangor or the prevalence of sea lions in shallow nearshore and intertidal waters of the base. Therefore, operation of LWI Alternative 3 is unlikely to increase sea lion predation on salmonids or other marine fish along the Bangor shoreline.

Underwater Noise

Similar to LWI Alternative 2, the operation of LWI Alternative 3 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. However, under LWI Alternative 3, some increase in underwater noise, even though intermittent and localized, would occur from the anchor chains and PSB feet when they come in contact with the bottom or other LWI structures. This noise is not, however, expected to be sufficient to cause nearshore-migrating juvenile salmon to alter their normal migration route. As a result, underwater noise that would occur during the operation of LWI is not anticipated to affect the long-term presence or behavior of fish in the project area.

Summary of Impacts and ESA-Listed Salmonids Determination

The operational effects of LWI Alternative 3 on nearshore NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be much smaller for Alternative 3 than for LWI Alternative 2. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

*ESA-Listed Hood Canal Rockfish*

Rockfish Habitat Requirements

Similar to the conclusions noted above for operation of LWI Alternative 2, operation of LWI Alternative 3 would not result in adverse impacts on currents at a scale that would affect larval retention, water quality, or increase the prevalence of exotic species. Underwater noise from vessel operations is not anticipated to rise to a level that would limit rockfish occurrence. The greatest difference between the two alternatives would be the smaller overwater structure area and in-water piles for Alternative 3, and the absence of the in-water mesh. Although bocaccio, yelloweye rockfish, and canary rockfish are extremely rare in Hood Canal waters, the presence of the LWI structures under Alternative 3 would shade some portions of benthic habitats, potentially inhibiting the growth of marine vegetation. In addition, the structure-supporting piles and anchoring systems would convert localized areas of existing soft-bottom benthic habitat to in-water hard substrate structures that could have minor impacts to local prey availability. However, these impacts would be minor in scope and have the potential to affect only a very small proportion of the available habitat within Hood Canal.

Nevertheless, operation of LWI Alternative 3 may affect bocaccio, canary rockfish, and yelloweye rockfish. No operational stressors associated with the proposed project are anticipated in designated rockfish critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

*NON-ESA-LISTED SALMONIDS*

Impacts described above for ESA-listed salmonids due to operation of LWI Alternative 3 would be similar for other salmonids potentially occurring in the project area.

*FORAGE FISH*

Because the effects on nearshore water and sediment quality are similar for LWI Alternative 2 and Alternative 3, the operational impacts on these habitats with respect to forage fish would also be similar. Alternative 3 would also be similar to Alternative 2 in terms of nighttime lighting, which would be used very infrequently (security responses only) with little or no risk of attracting forage fish, altering behavior (including migration), or increasing the risk of predation. As with Alternative 2, vessel activity associated with Alternative 3 would not increase over existing conditions, and would not increase to levels that would alter existing forage fish distribution and occurrence along the shoreline. Additionally, operation of Alternative 3 would not result in changes in the plankton community (the primary forage fish resource), and this resource would continue to occur in the project vicinity. However, as discussed above, operation of Alternative 3 may result in minor impacts to nearshore benthic and vegetated habitats utilized for foraging and refuge.

Operation of LWI Alternative 3 is not anticipated to impact surf smelt or Pacific herring spawning habitats or their reproductive success, because surf smelt or Pacific herring spawning grounds have not been documented along the 4.3-mile (7 kilometer) long Bangor waterfront (Penttila 1997; Stout et al. 2001; WDFW 2013b; NAVFAC Northwest 2014). However, at the north LWI project site, Pacific sand lance spawning habitat has been documented from the proposed abutment location southward (Figure 3.3–4, Section 3.3.1.5.3). At the south LWI project site, spawning habitat has been documented approximately 500 feet (150 meters) north of the proposed abutment location. As described for LWI Alternative 2, sand lance spawning habitat in the footprint of the north LWI project site abutment, abutment stair landings, and piles supporting the observation posts (Alternative 3 only) would be lost, and the quality of sand lance spawning habitat in the immediate surrounding area of these structures would be reduced compared to existing conditions. The loss and potential reduction in quality of sand lance spawning habitat would not occur at a scale that would affect the overall population of sand lance in Hood Canal, or their availability as a food source to predators dependent on these populations. However, should sand lance no longer occur in the immediate vicinity of the project site due to the new structures, they would also no longer be available to predators in the immediate project vicinity. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC 2014). If ongoing studies find this site is being utilized by forage fish, it would experience similar impacts as described for the north LWI project site.

Although the LWI extends across intertidal and shallow subtidal habitats used as a nearshore migratory pathway, the presence of the floating PSBs and the limited shade they would cast would not represent a substantial in-water structure or overwater shade barrier to nearshore fish migration. The observation post piles that would occur at either the north or south LWI would not block nearshore forage fish movement because they would not extend across the nearshore migration route, they would be separated from each other, and they would not be of sufficient size to cast nearshore shade that would alter species behavior. Even the close proximity of these structures to documented Pacific sand lance spawning habitat at the north LWI should have little or no effect on the movement of adults migrating toward or larvae emerging from these locations. However, although no documented spawning habitat occurs at the south LWI project site, the grounding of the PSB pontoons would occur adjacent to Pacific sand lance spawning habitat at the LWI project site. Function of these spawning habitats may be slightly impacted, but the impacts would be minor in the context of the total available sand lance spawning habitat in Hood Canal.

*OTHER MARINE FISH SPECIES*

Operational impacts on other marine fish species for LWI Alternative 3 would be similar to those described for salmonids above. Alternative 3 would maintain water and sediment quality in the project area (Sections 3.1.2.2.2 and 3.1.2.2.3). In addition, Alternative 3 would include fewer in-water and over-water structures, and, most importantly, would not include the pile-supported pier and associated in-water mesh that would occur perpendicular to the shoreline under LWI Alternative 2. Minor reductions in marine vegetation and benthic productivity from shading and the daily grounding of PSB pontoons in intertidal habitats may occur. Alternative 3 would have fewer overall operational impacts on other marine fish species compared to Alternative 2.

#### 3.3.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on fish during the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.3–4.

## Table 3.3–4. Summary of LWI Impacts on Fish

| Alternative | Environmental Impacts on Fish |
|---|---|
| LWI Alternative 1: No Action | No impact. |
| LWI Alternative 2: Pile-Supported Pier | *Construction:* Temporary degradation of turbidity and nearshore physical barriers; potential temporary decrease in function of habitats and aquatic vegetation used for foraging and refuge. Underwater noise guideline for behavioral disturbance and thresholds for injury would be exceeded during pile driving (this action would only occur during in-water work windows when juvenile salmon are generally not present). Potential disturbance of vegetated shallow-water habitats including 1.1 acre (0.43 hectare) of eelgrass habitat.<br>*Operation/Long-term Impacts:* Potential localized changes in fish habitat including barrier effects on juvenile and adult migratory fish, and minor loss of forage fish spawning habitat (north LWI) and supratidal habitat. |
| | *ESA:* Alternative 2 "may affect, not likely to adversely affect" Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).<br>*EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. |
| LWI Alternative 3: PSB Modifications (Preferred) | *Construction:* Temporary degradation of turbidity and nearshore physical barriers; temporary decrease in function of habitats and aquatic vegetation used for foraging and refuge. No in-water pile driving. Potential disturbance of vegetated shallow-water habitats, including 1 acre (0.39 hectare) of eelgrass habitat, representing a smaller impact on marine habitats utilized by fish than would occur under Alternative 2.<br>*Operation/Long-term Impacts:* Localized changes in fish habitat including a much smaller, but possible, barrier effect on juvenile and adult migratory fish, compared to Alternative 2. Minor loss of forage fish spawning habitat (north LWI) and supratidal habitat. |
| | *ESA:* Alternative 3 "may affect, not likely to adversely affect" Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).<br>*EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. |
| **Mitigation:** BMPs and current practices to reduce and minimize impacts on marine fish are described in Section 3.3.1.8.3. Under either alternative, proposed compensatory aquatic mitigation (Appendix C, Section 6.0) would compensate for the project's aquatic habitat impacts. | |
| **Consultation and Permit Status:** The Navy addressed impacts on ESA-listed marine fish and MSA-covered habitats under consultation with the NMFS West Coast Region office under the ESA and MSA. An EFH Assessment (EFHA) was submitted to the NMFS West Coast Region office on March 10, 2015. A Biological Assessment (BA) was submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office on March 10, 2015 and a revised BA was submitted on June 10, 2015. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the effect determinations noted above. In a concurrence letter dated March 4, 2016, USFWS stated that the LWI project impacts to bull trout are not measurable and therefore insignificant. | |

BMP = best management practice; EFH = Essential Fish Habitat; ESA = Endangered Species Act; MSA = Magnuson-Stevens Act; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service

### 3.3.2.3. SPE PROJECT ALTERNATIVES

#### 3.3.2.3.1. SPE ALTERNATIVE 1: NO ACTION

The SPE would not be built under the No Action Alternative and overall operations would not change from current levels. Therefore, the marine fish community would not be impacted under the SPE No Action Alternative.

#### 3.3.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION OF SPE ALTERNATIVE 2

Marine habitats used by fish species that occur along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and other habitats, including piles used for structure and cover. The following sections describe project-related effects on physical and biological factors, including impacts on the abundance and distribution of marine fish that could occur along the Bangor waterfront during construction.

*ESSENTIAL FISH HABITAT*

As detailed in the EFH Assessment, the primary construction-related impacts of concern for EFH would include underwater noise generated from pile driving, marine benthic and vegetation community disturbance, substrate disruption and turbidity from pile driving, barge anchoring, and water column and substrate shading from construction barges and structures (detailed in Sections 3.1.2, 3.2.2, and Appendix D). Construction impacts on macroalgae could impact suitable habitat areas for various life stages of some EFH species. Up to 1 acre (0.42 hectare) of nearshore marine habitat and 2.9 acres (1.2 hectares) of habitats in deep water would potentially be disturbed during construction of SPE Alternative 2 (Section 3.2.2.3.2). Of those 3.9 acres, approximately 0.27 acre (0.11 hectare) supports marine vegetation communities. Mitigation measures, BMPs, and current practices for the protection of salmonids, described above in Section 3.3.1.8.3 and Appendix C, would minimize impacts on EFH due to construction.

Construction of SPE Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. However, based on review of EFH species known or likely to occur in Hood Canal; findings pertaining to EFH species occurrence in waters along the Bangor waterfront, based on site-specific fish surveys; review of the life histories, habitat requirements, and potential conservation measures from the FMPs; as well as review of the mitigation measures developed to prevent adverse effects on ESA-listed fish species and their habitats, it is concluded that the current project approach and mitigation measures sufficiently address concerns pertaining to the potential for adverse construction-related effects on EFH, as detailed below.

*THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN*

Due to the similarity of life histories within ESA-listed species groups (salmonids and rockfish), impacts on ESA-listed species are discussed by listed species group. As a result, the species group *ESA-Listed Hood Canal Salmonids* includes the following: Puget Sound Chinook, Hood

Canal summer-run chum salmon, Puget Sound steelhead, and bull trout. The species group *ESA-Listed Hood Canal Rockfish* includes bocaccio, yelloweye rockfish, and canary rockfish.

*ESA-Listed Hood Canal Salmonids*

Potential impacts of the proposed project on Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout and the nearshore habitats they use are discussed below. Some project-related impacts could indirectly impact salmonids through alteration of nearshore habitats (e.g., aquatic vegetation disturbance), whereas other impacts (e.g., underwater noise) can directly affect a given species that occurs during the construction period. While some construction-related impacts may permanently or temporarily degrade one or more marine habitat constituents, construction may have little or no impacts on other constituents. Although juvenile salmonid species that are dependent on shoreline habitats as a migratory pathway would not be able to avoid nearshore construction activities as easily as adults, the number of juvenile salmon present during construction would be minimized by utilizing the in-water work window (July 15 to January 15). In-water work windows are based on the best available site-specific information for protected fish species. Adherence to the in-water work window generally ensures that construction of in-water structures would have no more than a minimal direct effect on listed juvenile salmonids in the project area.

Salmonid Marine Habitat Conditions

Impacts on marine habitats used by ESA-listed Hood Canal salmonids would be similar for all listed and non-ESA-listed salmonid species, as well as forage fish and other marine fish species. The following impact assessment for marine fish summarizes project-related impacts on marine fish and the aquatic habitats upon which they depend at NAVBASE Kitsap Bangor.

Water and Sediment Quality

As discussed in Section 3.1.2.3.2, construction-related impacts on water quality from SPE Alternative 2 would be limited to temporary (two in-water work seasons) and localized changes associated with resuspension of bottom sediments during pile installation. While large increases in turbidity have the potential to damage fish gills, the proposed project would only result in small-scale increases of suspended sediments (Section 3.1.2.3.2) and is not expected to result in gill tissue damage to salmonids. Studies investigating similar impacts to steelhead and coho salmon from larger scale sediment dredging operations have shown that increased turbidity levels from these activities did not cause salmonid gill damage, although other adverse effects were evident (Redding et al. 1987; Servizi and Martens 1991). For example, Redding et al. (1987) found that coho and steelhead were more susceptible to bacterial infection and displayed reduced feeding rates when exposed to elevated turbidity levels. Further, Servizi and Martens (1991) found that coho were more susceptible to viral infections when exposed to elevated turbidity and postulated that other impacts include reduced tolerance to environmental changes. Turbidity attributed to bubble curtains is dependent on whether the unit design is confined or unconfined. Because sediment disturbance is expected to be temporary and intermittent in nature, and fish are expected to avoid the immediate vicinity of construction activities, no long term effects to salmonid fitness are expected. However, elevated turbidity could temporarily decrease the availability of prey in the immediate vicinity, or reduce the ability of salmonids to detect and capture prey species.

Because concentrations of organic matter in NAVBASE Kitsap Bangor sediments are low (Table 3.1–4; Section 3.1.1.1.3), resuspension of these sediments is not expected to alter or depress DO below levels specified by water quality standards. In surveys conducted along the Bangor waterfront from 2005 to 2006, DO was measured at levels below the EQ standard of 7.0 mg/L, but not below the level considered to have adverse impacts on fish (5 mg/L) (Newton et al. 2002). Construction of the SPE Alternative 2 would not result in violations of water quality standards for DO or cause local decreases to levels that would impact the health of fish. Therefore, construction of SPE Alternative 2 would not adversely affect water quality in the project vicinity.

The primary adverse impact on water quality from in-water construction activities, including pile installation, barge and tug anchoring, and propeller wash, would be suspension of bottom sediments and formation of a turbidity plume in near-bottom waters. Resuspended sediments could cause the release of sediment-bound contaminants to near-bottom waters. However, sediments at the SPE project site contain low concentrations of organic carbon (i.e., TOC) and, along with metals, are characterized as having contaminant levels below applicable state standards (Table 3.1–4; Section 3.1.1.1.3). Therefore, increases in chemical contaminant concentrations in marine waters as a result of sediment resuspension during pile installation would be minor. Because suspended sediment and contaminant concentrations would be low, and exposures would be limited to the in-water construction period during each of the two in-water construction years, localized, acute, or chronic toxicity impacts would not occur.

Construction of the SPE Alternative 2 would not impact water temperature or salinity because construction activities would not discharge a waste stream. Steel and concrete piles installed for SPE Alternative 2 would be inert and would not contain creosote or other contaminants that could be toxic or biologically available.

Stormwater runoff impacts and protective measures would be similar to those described in Section 3.1.1.2.3 for water quality impacts. Therefore, construction activities associated with SPE Alternative 2 would not result in alterations of water temperature or salinity and would not violate any water quality standards.

Although some level of localized changes in sediment grain size is expected during construction activities for SPE Alternative 2, such as fine-grained sediments dispersing and settling outside the project site, impacts on sediment quality would be limited and localized to the general project area (Section 3.1.2.3.2). Construction activities would not discharge contaminants or otherwise appreciably alter the concentrations of trace metal or organic contaminants in bottom sediments. Although sediments could be impacted by oil spills during in-water construction, the existing NAVBASE Kitsap Bangor spill prevention and response plans would reduce the potential for these impacts. If an accidental spill were to occur, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. These cleanup procedures would minimize impacts on the surrounding environment.

Another possible source for construction-related impacts on water and sediment quality would be from accidental debris spills into Hood Canal from barges or construction platforms. Debris spills could impact bottom sediments and create nuisance conditions by adding materials that could represent obstructions. The facility response plan for the Bangor waterfront provides for responses to potential spills. The construction contractor would be required to retrieve and clean up any accidental debris spills using BMPs and current practices in accordance with the debris management procedures that would be developed and implemented per the Mitigation Action Plan (Appendix C). As with the in-water construction activities, any removal of in-water construction debris would occur during the in-water work window. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

Physical Habitat and Barriers

During construction of SPE Alternative 2, the impact of physical barriers on marine fish would be greatest in the habitats used by offshore-occurring larger juvenile (e.g., Chinook and coho salmon) and adult salmonids, but not for the smaller nearshore migrating salmonids (e.g., chum and pink salmon) that migrate shoreward of the project footprint. Relative to younger age-classes, adult salmonids of all species have much greater mobility, and are unlikely to experience the same shallow water barrier effect as nearshore-dependent juvenile salmonids. In general, adult salmonids would likely migrate around this activity, with little or no overall delay in their movements.

Nightingale and Simenstad (2001a) cite multiple studies that indicate juvenile salmon, notably fry, migrate within shallow nearshore waters. These studies have shown that smaller juveniles (e.g., fry less than 2 inches [5.1 centimeters]) migrate along the shoreline in waters less than 3 feet (0.9 meter) in depth (Schreiner 1977; Bax 1982; Whitmus 1985). Simenstad et al. (1999) refer to shallow-water habitat as "that portion of the nearshore estuarine and marine environment habitually occupied by migrating salmon fry (i.e., approximately 1 to 3 inches [2.5 to 7.6 centimeters] long), which includes the intertidal zone to approximately -6 feet MLLW." The most numerically abundant juvenile salmonids that occur along the waterfront are the smaller chum and pink salmon (SAIC 2006; Bhuthimethee et al. 2009) that would migrate shoreward of the vast majority of in-water construction activity. If larger juvenile salmonids (e.g., Chinook and coho) that occur offshore into deeper waters (Bax et al. 1980) are present during the in-water work window, they would likely encounter the construction activity and alter their migration route either shoreward or further offshore to avoid the activity.

During construction, removal of the existing wave screen on the shoreward side of Service Pier and installation of a similar-sized wave screen under the SPE is unlikely to adversely affect fish migration compared to existing conditions. All in-water construction would occur during the allowable in-water work window when juvenile salmonids are least abundant. Adult and subadult salmonids, should they occur during construction activities, would likely avoid the immediate vicinity of in-water construction activity, but would not be prevented from migrating around this activity.

Approximately 50 24-inch (60-centimeter), and 230 36-inch (90-centimenter), steel pipe support piles would be driven during the first in-water work window to support the pier extension. 105 18-inch (45-centimeter) square concrete piles would be driven during the second in-water work window to serve as fender piles. The footprint of the more shallow, southern edge of the pier would occur at water depths greater than 30 feet (9 meters) below MLLW (Figure 3.1–4), just beyond the nearshore juvenile salmonid migratory pathway, defined as occurring from 12 feet (4 meters) above MLLW to 30 feet below MLLW. However, due to the close proximity to this pathway and construction disturbance that would extend beyond the footprint into the pathway, barrier impacts on salmonids could occur due to construction activity.

All construction activities would be conducted during the in-water work window (July 15 to January 15). Fish surveys along the Bangor shoreline in the 1970s and 2005 to 2008 indicated that most (approximately 95 percent) of the juvenile salmonid migration is complete by this time (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009). Returning adult salmonids, including the shoreline preferring summer-run chum, may alter their migration patterns somewhat to avoid any active in-water construction activity. However, although adult salmonids would likely avoid the immediate vicinity of in-water construction activity, this barrier affect would be minor and not prevent adult salmonids from migrating southward along the shore to their natal streams for spawning. Although construction of SPE Alternative 2 would occur at a time when salmonids are least abundant, construction activities could temporarily increase of in-water barriers encountered by salmonids that potentially would be present during the construction period.

Biological Habitat

*Prey Availability.* As discussed in Appendix B, both benthic invertebrate prey and forage fish are important food resources for juvenile salmonids. This section addresses construction-related impacts from SPE Alternative 2 to the localized benthic prey community, with the discussion of impacts on the forage fish community provided below. Construction of SPE Alternative 2 may result in localized and temporary reductions of the benthic community during pile placement and other construction-related disturbances (Section 3.2.2.3.2). Since the construction activity would occur offshore of the principal juvenile salmonid migratory pathway, smaller chum and pink salmon that are dependent on benthic invertebrates as a prey source during their out-migration would likely experience little or no change in available benthic food resources. Larger salmonids (e.g., Chinook and coho) that migrate further offshore in the neritic zone are generally less dependent on benthic invertebrates. Benthic organisms that are impacted during in-water construction would be expected to reestablish over a 3-year period (CH2M Hill 1995; Romberg et al. 1995; Parametrix 1994a, 1999; Anchor Environmental 2002; Vivan et al. 2009). Total anticipated benthic impacts could last up to 5 years (2 construction years, 3 years for reestablishment) (Section 3.2.2.3.2).

*Aquatic Vegetation.* The aquatic vegetation habitat of principal concern for juvenile salmon foraging and refuge is eelgrass (*Zostera* sp.) (Simenstad et al. 1999; Nightingale and Simenstad 2001a,b; Redman et al. 2005). Intertidal and subtidal areas with extensive areas of eelgrass provide habitat for amphipods, copepods, and other aquatic invertebrates

(Mumford 2007) used by juvenile salmonids as food resources. Copepods and other zooplankton represent the major food base for Puget Sound juvenile fish (Simenstad et al. 1979), including salmonids. In addition, at these small, vulnerable life stages, juvenile salmonids use these nearshore vegetated habitats as a refuge from predators during out-migration. Although the two largest eelgrass beds along the Bangor shoreline occur near Devil's Hole and Cattail Lake, a relatively narrow band of eelgrass occurs along nearly the entire shoreline (SAIC 2009).

Since construction water depths would mostly be greater than 30 feet (9 meters) below MLLW in the SPE Alternative 2 footprint, impacts on marine vegetation, including eelgrass beds, would be minimal (Section 3.2.2.3.2). This portion of the narrow nearshore strip of eelgrass would largely be unaffected by in-water construction activities during pile driving and decking installation. Turbidity would have little effect on nearby eelgrass beds, resulting in minimal plant loss.

The presence of overwater barges and structures and the shade they would cast during construction would also generally occur in deeper waters, with no impact to eelgrass beds. SPE construction would have little effect on the productivity of aquatic vegetation (Section 3.2.2.3.2). Any construction activities that would result in impacts, even though minimal, on marine vegetated communities from the Proposed Action would be compensated for via the proposed compensatory aquatic mitigation action (Appendix C, Section 6.0).

*Underwater Noise*

Construction of the SPE Alternative 2 would result in increased underwater noise levels in Hood Canal, due primarily to the installation of support and fender piles for these structures. Some noise would also be generated from support vessels, small boat traffic, and barge-mounted equipment, such as generators. However, the most significant in-water noise potentially affecting marine fish would be created by pile driving using an impact hammer. A detailed description of underwater noise calculations is provided in Appendix D.

The following analysis for underwater noise impacts on fish potentially resulting from SPE Alternative 2 utilizes source levels detailed in Table 3.3–5 below.

**Table 3.3–5. Unattenuated Source Levels for SPE Acoustic Modeling**

| IMPACT DRIVING | | | |
|---|---|---|---|
| **Pile Size / Type** | **dB RMS re: 1 μPa @ 33 feet (10 meters)** | **dB peak re: 1 μPa @ 33 feet (10 meters)** | **dB SEL re: 1 μPa$^2$ sec @ 33 feet (10 meters)** |
| 36-inch (90-cm) steel pipe | 194 | 205 | 181 |
| 24-inch (60-cm) steel pipe | 193 | 210 | |
| 18-inch (45-cm) square concrete | 170 | 184 | 159 |
| **VIBRATORY DRIVING** | | | |
| **Pile Size / Type** | **dB RMS re: 1 μPa @ 33 feet (10 meters)** | **dB peak re: 1 μPa @ 33 feet (10 meters)** | **dB SEL re: 1 μPa$^2$ sec @ 33 feet (10 meters)** |
| 36-inch steel pipe | 166 | n/a | n/a |
| 24-inch steel pipe | 161 | | |

dB = decibel; g = gram; RMS = root mean square; SEL = cumulative sound exposure level
Sources: Illingworth & Rodkin 2012; Navy 2014a

For SPE Alternative 2, the primary method of installation for the 24- and 36-inch (60- and 90-centimeter) steel piles would be vibratory driving. An impact hammer would be utilized to “proof” piles if needed; proofing a steel pile is assumed to require no more than 200 strikes of the impact hammer. Square concrete piles would be driven with an impact hammer only and require no more than 300 strikes per pile. To reduce underwater noise levels and associated impacts on underwater organisms during active impact pile driving of steel piles, a bubble curtain would be deployed. Bubble curtain performance is discussed in detail in Appendix D. For analysis under this Alternative, deployment of a bubble curtain is assumed to result in attenuation of source levels by 8 dB.

It is possible that the impact and vibratory pile drivers would operate concurrently at times. In this case, because the source levels for the impact driver are so much greater (several orders of magnitude) than source levels for vibratory drivers, the combined noise levels generated by concurrent operation of the two types of drivers would not be measurably greater than those generated by operation of the impact driver alone. Therefore, impact analysis of noise from operating the impact driver represents the reasonable worst-case noise impacts for pile driving under SPE Alternative 2.

Similarly, since 24- or 36-inch (60- and 90-centimeter) steel pipe piles may be driven interchangeably during the first in-water work window, the acoustic model utilizes the highest source levels (i.e., those of the 36-inch steel piles except for the dB peak value which is higher for 24-inch piles) for determining effect ranges (Table 3.3–6) for the various injury and behavior thresholds.

**Table 3.3–6. SPE Alternative 2 Fish Threshold and Guideline Levels and Effect Ranges for the Operation of Impact Hammer and Vibratory Pile Drivers**

| Fish Threshold and Guideline Levels[1,2] | SPE Alternative 2 Effect Ranges | | |
|---|---|---|---|
| | First In-Water Work Window | | Second In-Water Work Window |
| | 36-inch Steel Pile[3] | 24-inch Steel Pile[3] | 18-inch Concrete Pile |
| 206 dB peak, impact hammer (injury) | 18 feet (5 meters) | 10 feet (3 meters) | 1 foot (< 1 meter) |
| 187 dB SEL (injury to fish ≥ 2 g) | 607 feet (185 meters) | | 92 feet (28 meters) |
| 183 dB SEL (injury to fish < 2 g) | 1,122 feet (342 meters) | | 171 feet (52 meters) |
| 150 dB RMS, impact hammer (behavioral for all fish) | 8,242 feet (2,512 meters) | 7,068 feet (2,154 meters) | 707 feet (215 meters) |
| 150 dB RMS, vibratory driver (behavioral for all fish) | 384 feet (117 meters) | 178 feet (54 meters) | n/a |

dB = decibel; g = gram; RMS = root mean square; SEL (for this table) = Cumulative Sound Exposure Level

1. Underwater noise thresholds are taken from Fisheries Hydroacoustic Working Group (2008).
2. The underwater noise guideline for behavior is taken from Hastings (2002).
3. An 8 dB reduction in sound pressure levels is incorporated in range estimate.

Figures 3.3–6a through –7b illustrate the areas in which sound levels at or above the various fish injury and behavioral thresholds could occur during pile driving under this Alternative. Impact driving of concrete piles generates lower intensity, lower impulse energy, and lower dominant frequencies than impact driving of steel piles. The overall amplitude of the signals is also lower than those from steel piles that are impact driven. Correspondingly, potential effects on fish from underwater noise generated during impact pile driving of concrete piles would be reduced compared to steel piles. Because of these differences, the effect distances over which underwater noise generated during pile driving would exceed the established underwater noise threshold criteria and guidelines are discussed separately.

Based on the small size of the potential area in which injurious peak sound levels could occur, as well as the conservative modeling assumptions described in the *Underwater Noise* section for LWI Alternative 2, the noise produced from pile installation is not likely to result in the injury or mortality for any listed fish species. Fish are expected to avoid the area in the immediate vicinity of in-water construction based on increased levels of human activity and disturbance in the water column. In addition, installation would be conducted during the in-water work window to minimize impacts on juvenile salmonids.

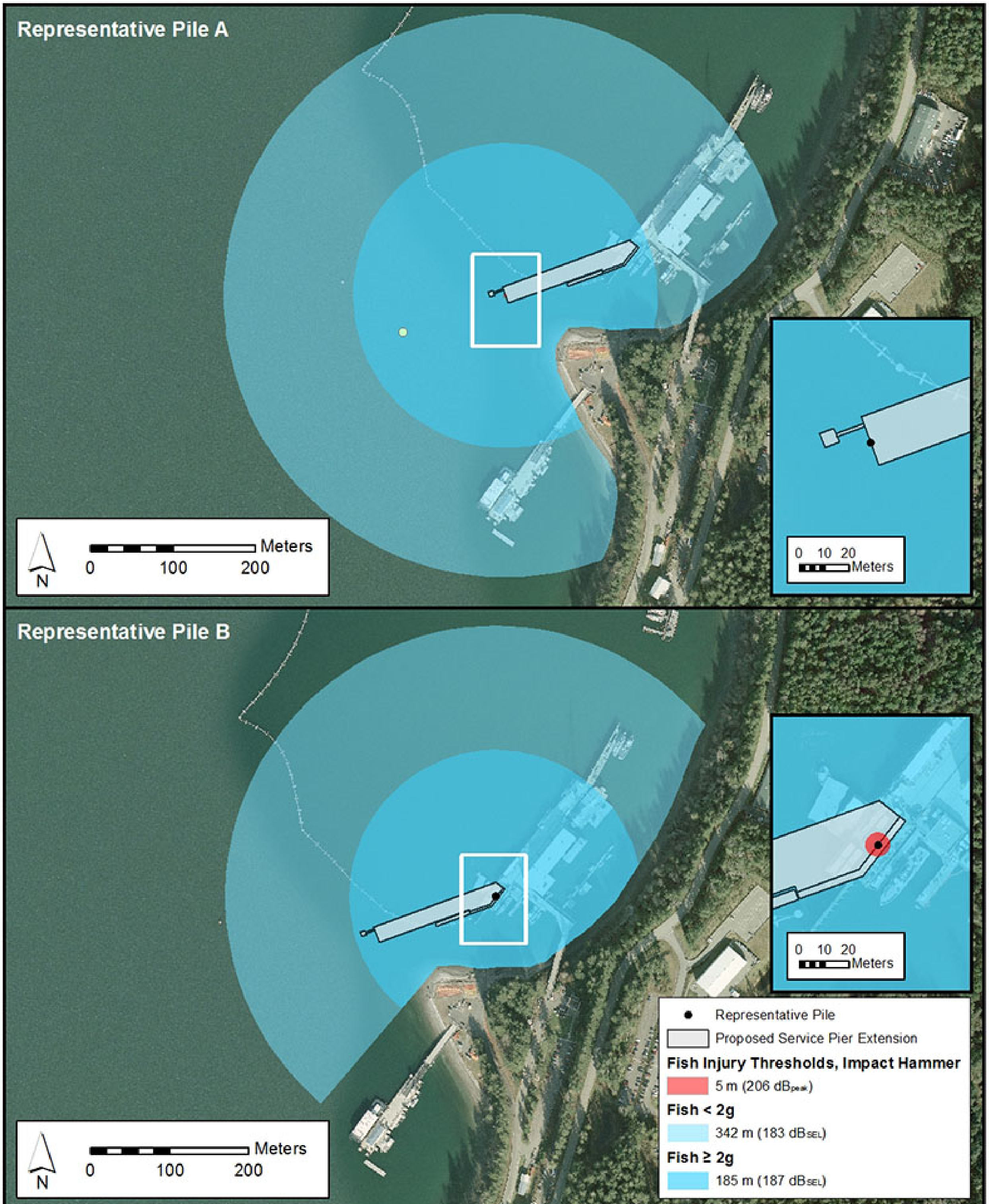


**Figure 3.3-6a. Representative View for Fish Injury Threshold due to 36-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 2**

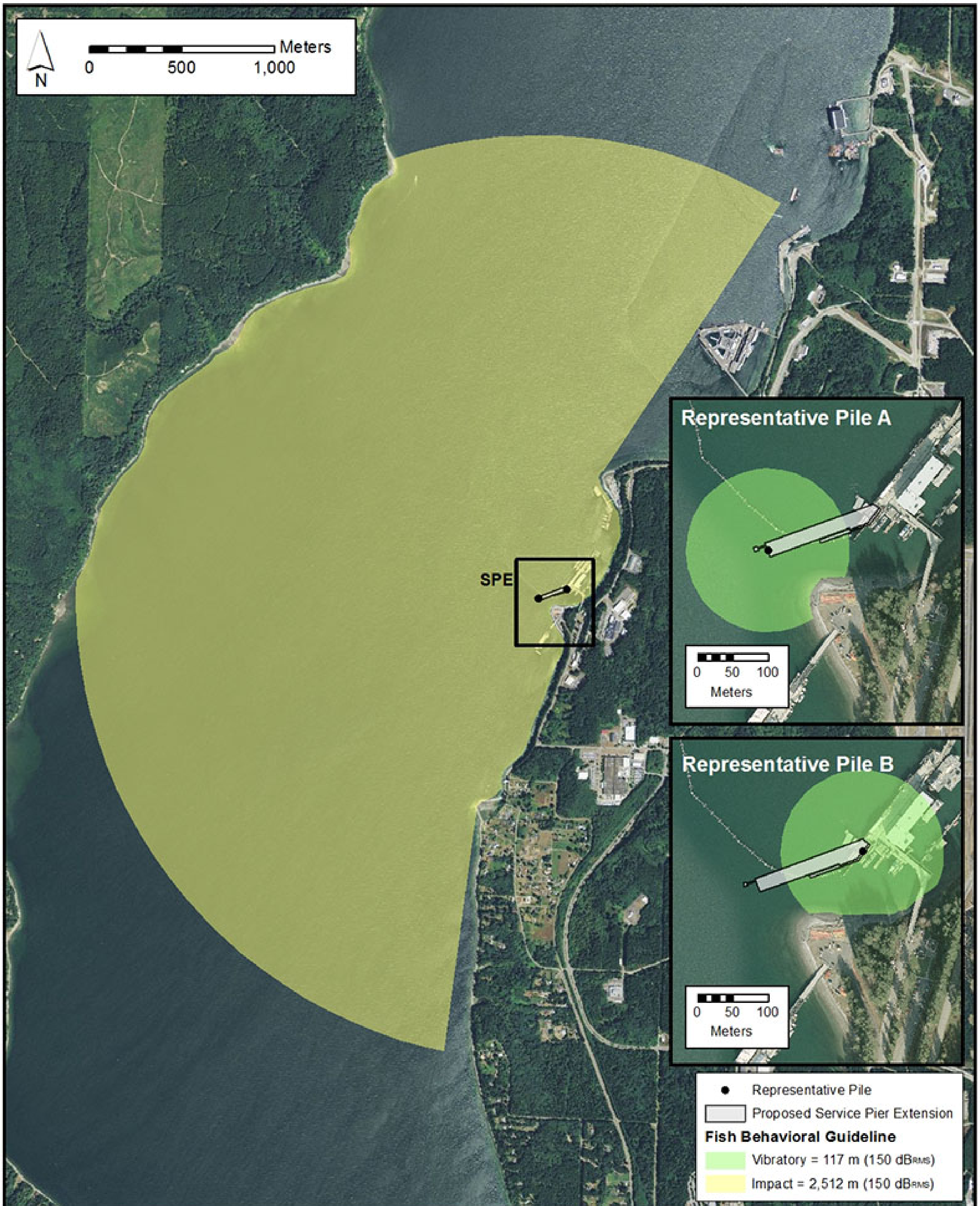


**Figure 3.3-6b. Representative View for Fish Behavioral Guideline due to 36-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 2**

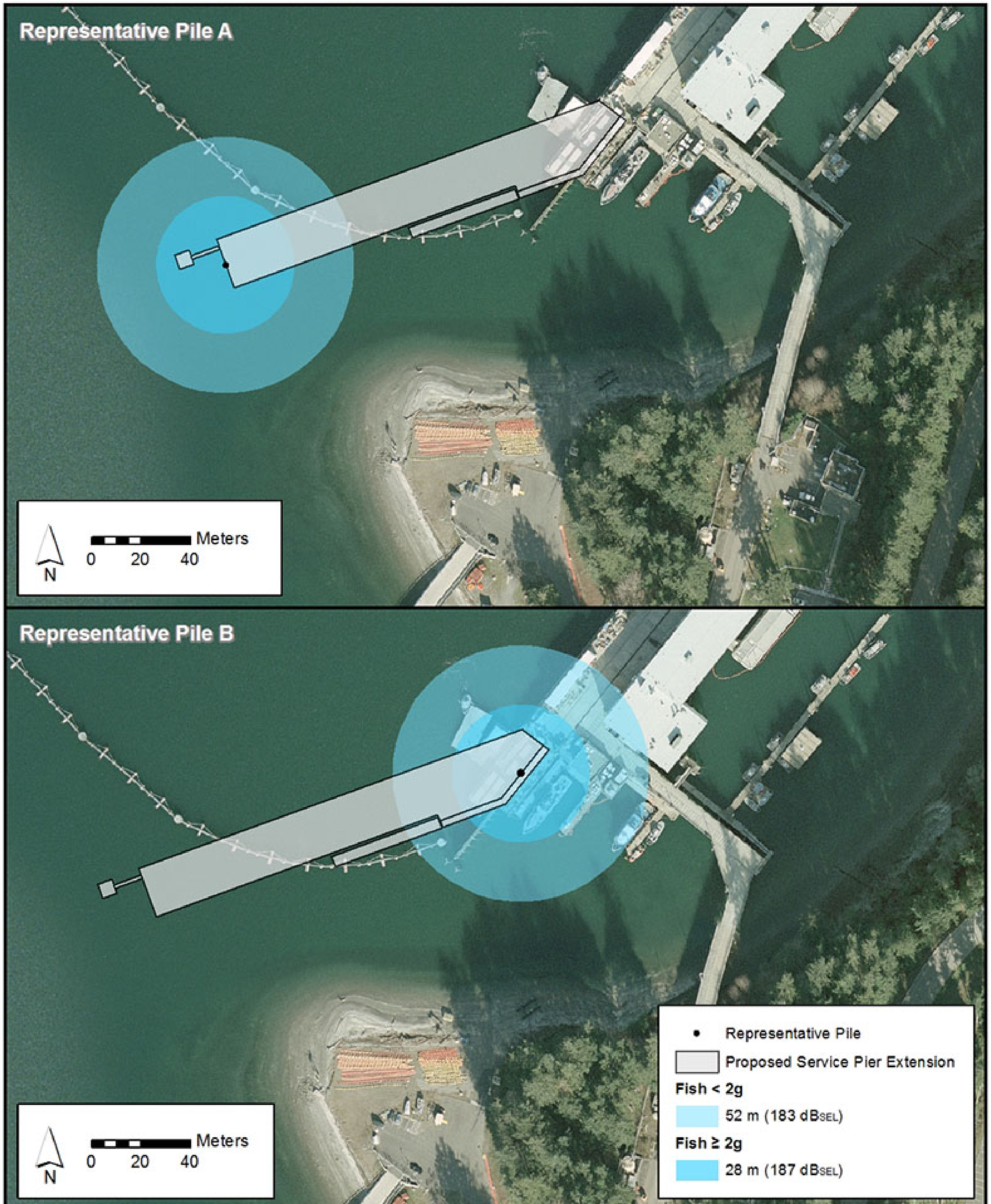


**Figure 3.3-7a. Representative View for Fish Injury Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 2**

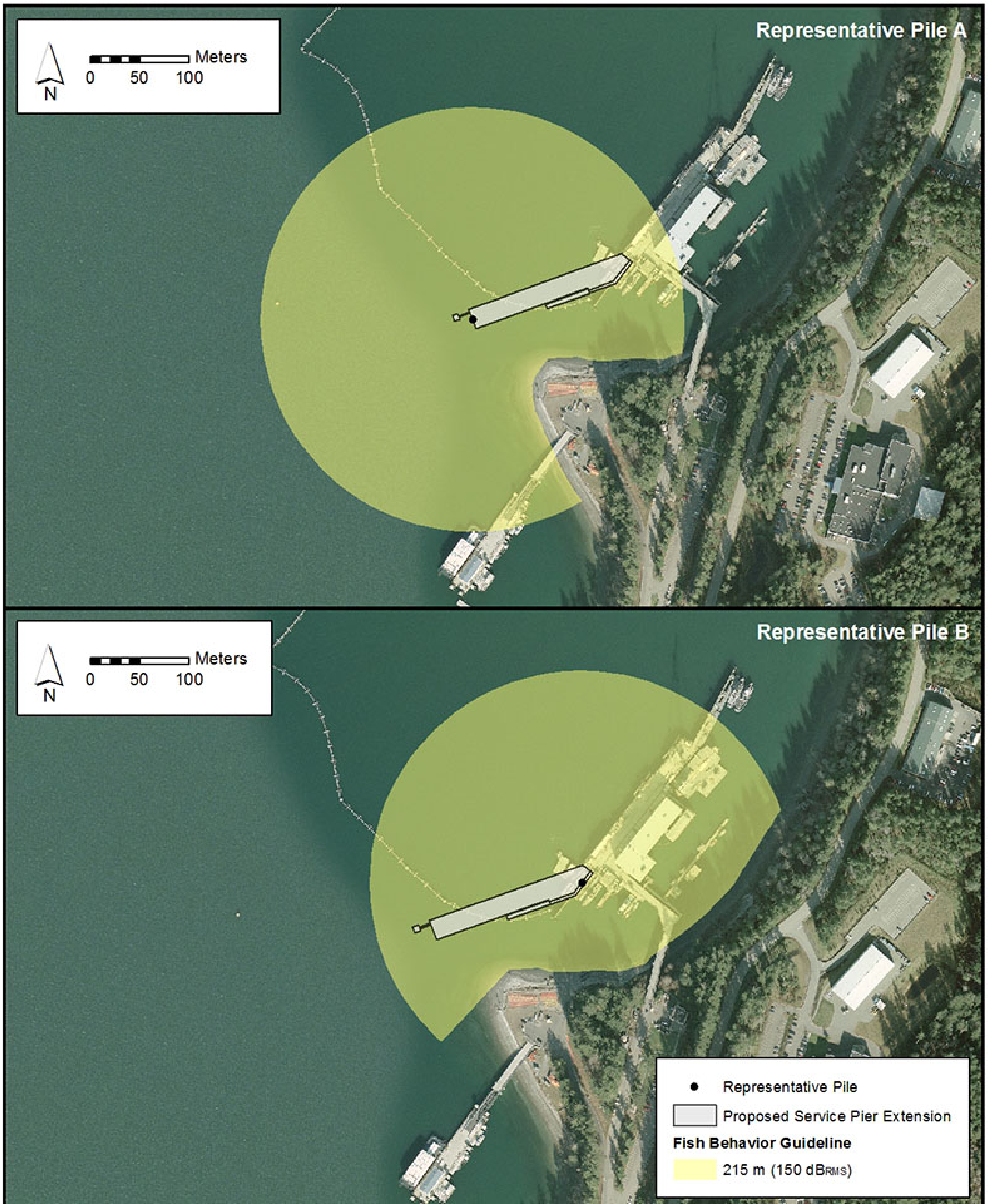


**Figure 3.3-7b. Representative View for Fish Behavioral Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 2**

*Potential Behavioral Effects*

Fish occurring within the effects range (Figures 3.3–6b and 3.3–7b, respectively) for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012), although these responses may resolve soon after pile driving ceases (NMFS 2014b). As explained in NMFS (2012), it is unlikely these minor changes in behavior would preclude a fish from completing any normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable.

In addition to the pile driving, other in-water work, including barge activity during construction of the pier and pier decks also would occur. Some noise also would be generated from support vessels, small boat traffic, and barge-mounted equipment, such as generators. However, levels are not expected to differ appreciably from those generated by other ongoing anthropogenic activity in the vicinity. Fish may temporarily alter their behavior but no long-term change in the occurrence of fish or their population composition in the vicinity of the project is expected.

Summary of Impacts and ESA-Listed Salmonid Determination

SPE Alternative 2 construction activities may result in temporary and intermittent (over two in-water work seasons) offshore (>30 feet [9 meters] below MLLW) impacts on water quality (e.g., increased turbidity), minor and temporary decreases in prey availability, benthic habitat conversion and loss, temporarily elevated noise levels, and non-eelgrass aquatic vegetation loss. This alternative would not cause a violation of state water quality standards or reduction in sediment quality (Section 3.1.2.3.2) due to adherence to appropriate water and sediment quality BMPs and current practices (Section 3.1.1.2.3). The presence of the barges and in-water construction activities occur offshore, out of the primary juvenile salmon migratory pathway, and would represent only a minor migratory barrier, limited to larger, offshore migrating juvenile and adult salmonids during construction. Pile driving activities would increase underwater noise above the injury thresholds and behavioral guideline for fish. Because construction of SPE Alternative 2 would occur during the in-water work window when salmonids are least abundant (July 15 to January 15), these impacts would be minimized due to the low risk of exposure.

Critical habitat PCEs for Puget Sound Chinook and Hood Canal summer-run chum that would be affected include estuarine areas, nearshore marine areas, and offshore marine areas. As noted in the PFMC (2014b) review, "some species of fishes, including Chinook salmon and Atlantic salmon (*Salmo salar*), have been shown to avoid continuous sounds (similar to vibratory pile driving) at frequencies below 30 Hz (infrasound), but not impulsive-type sounds (similar to those from impact pile driving) at frequencies above 100 Hz." Pile driving would produce noise above the fish behavioral thresholds during vibratory pile driving and be above the behavioral and injury thresholds during impact pile driving in the portion of the action area that contains critical habitat. However, effects to these PCEs would be discountable with implementation of a noise attenuation device during impact pile driving of steel piles, primarily installing piles using a vibratory pile driver.

Within the Hood Canal Subbasin, currently occupied riverine habitat is designated as Puget Sound steelhead critical habitat. Since DoD installations with current INRMPs are exempt from critical habitat designation, no critical habitat was designated at NAVBASE Kitsap Bangor. Underwater noise generated during pile driving would not exceed established thresholds in critical habitats designated for Puget Sound steelhead.

Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment disturbance, and the avoidance and minimization measures described above and in Appendix C, any potential effects to Puget Sound Chinook salmon, Puget Sound steelhead, Canal summer-run chum, or bull trout would be discountable. Any stressors that have the potential to affect critical habitat PCEs (e.g., disturbed sediments) would be highly localized to the immediate vicinity of in-water construction, and would not reach proposed or designated critical habitat. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

*ESA-Listed Hood Canal Rockfish*

Due to the similarity of life histories and habitat requirements between ESA-listed rockfish species, project-related impacts on these species are discussed by this species group rather than as individual species.

Threats to the recently listed bocaccio, yelloweye rockfish, and canary rockfish can be caused by low DO, commercial and sport fisheries (notably mortality associated with fishery bycatch), reduced kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including exotic species), derelict gear, climate change, species interactions (including predation and competition), diseases, and genetic changes (Palsson et al. 2009; Drake et al. 2010). The combination of these factors, in addition to rockfish particular life history traits, has contributed to declines in rockfish species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516).

<u>Rockfish Habitat Requirements</u>

Larval and juvenile rockfish are dependent on a variety of habitat factors, including suitable current patterns for larval transport to suitable recruitment habitat, good water quality, and abundant food resources (Palsson et al. 2009). Due to typically poor rockfish dispersal between basins, if habitat suitable for adult rockfish does not exist within a specific area, the abundance of adults would be low, as would the recruitment of juveniles into adjacent juvenile habitat. As rockfish have complex life history patterns that use specific food and habitat requirements at each life history stage (larval, juvenile, adult), effects on the habitats used at each stage can affect the long-term presence of these species in local and adjacent waters.

Since SPE Alternative 2 would neither increase commercial or sport fisheries nor increase the presence of derelict gear, fish disease, or climate or genetic change, these limiting factors are not discussed further.

Currents

Rockfish larvae are pelagic, with their movements somewhat influenced by prevailing currents within a given basin (Palsson et al. 2009). Even if adults are abundant and a strong class of larvae is produced in a given year, recruitment to suitable habitat can be limited, because larval survival and settlement are dependent on a wide variety of unpredictable chance events, including currents, climate, abundance of predators, suitable recruitment habitat, and other chance events (Drake et al. 2010). As summarized for coastal systems by Drake et al. (2010), onshore currents, eddies, upwelling shadows, and other localized circulation patterns create conditions that retain larvae rather than disperse them. In addition, the shallow sill (approximately 165 feet deep [50 meters]) at the mouth of Hood Canal further limits the circulation and exchange of water between this basin and waters of the Strait of Juan de Fuca and central Puget Sound (Babson et al. 2006). As a result, Puget Sound basins, including Hood Canal, have greater retention of and reliance on intra-basin rockfish larvae than coastal systems (Drake et al. 2010).

As discussed in Section 3.1.2.3.2, small-scale and temporary (over periods of hours) changes in current direction and intensity of flow are anticipated during construction. However, the overall circulation pattern and velocities into the nearshore and marine deeper-water areas along the Bangor waterfront would be relatively unaffected. Thus, in-water construction activity would have limited and localized effects on circulation and currents, with limited effects on rockfish larval recruitment.

Water Quality

Palsson et al. (2009) indicate that rockfish may avoid waters with DO conditions below 2 mg/L and temperatures greater than 11°C (Palsson et al. 2009). In 2002, 2003, 2004, and 2006, low-DO fish kills occurred in southern Hood Canal (Newton et al. 2007; Palsson et al. 2009). Rockfish, notably copper rockfish, experienced high mortality, with estimates of up to a quarter of all copper rockfish occurring at a southern Hood Canal marine preserve killed by these conditions (Palsson et al. 2009). However, within Hood Canal both chronic and episodic events of low DO are typically limited to southern Hood Canal, with this pattern not as prevalent in northern Hood Canal waters (Newton et al. 2007), including off NAVBASE Kitsap Bangor. When conditions are not suitable at depths where they are normally present, rockfish relocate to depths with more suitable conditions (Palsson et al. 2009; Drake et al. 2010), or they are exposed to impacts, including suffocation.

As noted for salmonids, the construction of SPE Alternative 2 would not affect DO concentrations in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. Further, the construction of SPE Alternative 2 would not result in water temperature increases. Therefore, rockfish would not experience elevated water temperatures as a result of SPE Alternative 2.

Limited information is available on the effects of turbidity on rockfish. However, the effects would likely be similar to those described above for salmonids. Although construction activities would temporarily increase suspended solids, the levels would be insufficient to cause severe gill irritation or result in fish loss through mortality and would return to existing conditions following the completion of in-water construction. If rockfish should encounter turbidity plumes with high levels of suspended sediment during construction activities, they would likely avoid these localized plumes.

Habitat Alteration

Rockfish habitat alteration can affect interrelated stressors identified by Drake et al. (2010) and Palsson et al. (2009), including reduction of suitable habitat, and increased competition and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

*Suitable Habitat.* As noted above, juvenile rockfish (as young as three to four months old) recruit to nearshore habitats that include algae-covered rocks or sandy areas with eelgrass or drift algae (Mitchell and Hunter 1970; Leaman 1976; Boehlert 1977; Shaffer et al. 1995; Johnson et al. 2003; Hayden-Spear 2006). While these studies indicate that the fish recruit to natural habitat encountered in offshore surface waters, other studies have found that post-larval juvenile rockfish also recruit to manmade, in-water structures (Emery et al. 2006; Love et al. 2005, 2006). Palsson et al. (2009) notes that structured habitat is "extremely" limited within Puget Sound waters. In addition, these types of structures also serve as habitat for sub-adult and adult lingcod, rockfish, and greenling (Love et al. 2002), which are potential predators of juvenile rockfish (see below). However, it is unlikely that juvenile rockfish would recruit to the piles as structured habitat during active in-water construction.

Nearshore marine vegetation potentially used for juvenile rockfish recruitment habitat would be affected during construction (Section 3.2.2.3.2. No dredging or removal of existing high-relief structured habitat potentially used by rockfish would occur during construction. However, reduction of marine vegetation in the project area during construction could reduce rockfish recruitment, if it occurs, at these locations. Relative to the total amount of habitat available for rockfish in the Puget Sound, these impacts would be negligible.

*Predation.* Construction activity is not expected to increase recruitment of rockfish predators to the project area or create a physical environment that increases the susceptibility of rockfish to predators. Barge movement, pile driving, decking installation, and other construction activities would create visual and auditory stimuli that most fish and fish predators would avoid. In addition, subadult and adult age classes of the three ESA-listed rockfish species generally prefer deeper-water habitats than occur within the construction footprint of the pier extension (other than potential larval recruitment to nearshore marine-vegetated habitats). Consequently, the presence of these species, even in the absence of construction activity, would be limited at best. Therefore, construction activities for SPE Alternative 2 are not expected to increase predation on juvenile or subadult rockfish.

*Competition.* Construction activities would not create an environment that would increase competition between rockfish and other marine fish species. In addition to the construction footprint occurring in waters shallower than rockfish generally prefer, these activities would create visual and auditory stimuli that most fish would avoid, including rockfish competitors.

Therefore, construction activities for SPE Alternative 2 are not expected to increase competition between listed rockfish and their competitors.

*Prey Availability.* During construction, bottom disturbance would result in decreased prey availability (Section 3.2.2.3.2) for juvenile rockfish. Construction of the SPE would not alter the plankton community used as a primary food source for larval rockfish (Section 3.2.2.3.2). Some prey species, such as surf perch and forage fish, for older, larger rockfish, may experience a decrease in habitat availability during construction due to the disturbance of vegetated marine habitats. As a result, older age classes of rockfish, should they occur in the immediate project vicinity, may experience a similar decrease in the small fish prey base during construction activities and associated underwater noise during pile driving. However, upon completion of pile driving, underwater noise levels would return to levels consistent with existing conditions and these prey species would no longer avoid the project vicinity.

During periods of active pile driving, construction of SPE Alternative 2 could temporarily affect (by behavioral disturbance or physical impacts) some rockfish prey species within the immediate project vicinity. However, planktonic food sources for larval rockfish are not expected to be affected.

*Exotic Species.* Exotic organisms, including nonindigenous marine vegetation that replaces existing native marine vegetation (notably eelgrass or kelp) in Puget Sound waters, could pose a threat to rockfish survival (Palsson et al. 2009; Drake et al. 2010). Currently, *Sargassum muticum*, a nonindigenous brown alga, is ubiquitous in Puget Sound nearshore waters where rocks and cobbles are present (Britton-Simmons 2004). Whether *S. muticum* affects rockfish settlement is not currently known (Palsson et al. 2009). Drake et al. (2010) suggest a possible threat to Hood Canal rockfish from *Ciona savignyi*, an invasive tunicate that is rapidly expanding its range in Hood Canal, and further note that invasive tunicates elsewhere have had widespread unspecified adverse effects on rocky-reef fishes, including rockfish.

Construction of the SPE would not increase the prevalence of exotic species in Hood Canal waters. None of the piles, decking, or fencing for this alternative would have occurred previously in marine waters and, therefore, would not include attached exotic organisms. In addition, the vessels used during construction would comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species. Therefore, construction of SPE Alternative 2 is not anticipated to facilitate the introduction, spread, or prevalence of exotic organisms along the Bangor shoreline or the Hood Canal basin.

<u>Underwater Noise</u>

An additional project effect on rockfish that is not discussed in Drake et al. (2010) as a stressor, but is briefly mentioned in Palsson et al. (2009), is elevated levels of underwater noise. In a caged fish study investigating the effects of a seismic air gun on five species of rockfish (*Sebastes* spp.), Pearson et al. (1992) found that behaviors varied between species. In general, however, fish formed tighter schools and remained somewhat motionless, thereby indicating behavioral effects.

Skalski et al. (1992) found that average rockfish catches for hook and line surveys decreased by 52 percent when occurring after the noise produced by a seismic air gun at the base of rockfish aggregations. Fathometer observations showed that the rockfish schools did not disperse but remained aggregated in schooling patterns similar to those prior to exposure to this noise. However, these aggregations did elevate themselves in the water column, away from the underwater noise source. Hastings and Popper (2005) indicate there are no reliable hearing data on rockfish, nor is it currently possible to predict their hearing capabilities based on morphology.

A more detailed description of the effects on fish from anticipated underwater noise levels expected during construction is provided above for salmonids. Currently, underwater noise impact thresholds do not differentiate between fish species (Fisheries Hydroacoustic Working Group 2008). Although salmonids and rockfish have very different appearances and life histories, both groups have internal air bladders to maintain buoyancy.

As described above for salmonids and summarized in Table 3.3–6, rockfish occurring within the range to effect during pile driving or proofing would potentially be exposed to elevated underwater noise levels.

Summary of Impacts and ESA-Listed Rockfish Determination

As noted above in Sections 3.3.1.3.5, 3.3.1.3.6, and 3.3.1.3.7, bocaccio, yelloweye rockfish, and canary rockfish are rare in Hood Canal waters and are generally limited in Hood Canal by the lack of suitable habitat. Construction of SPE Alternative 2 would result in small-scale changes in current velocity and flow around the in-water vessels. However, this effect would be too small and localized to alter existing nearshore currents or normal rockfish larval recruitment along the Bangor shoreline. Minor, temporary (two in-water work seasons), and localized effects on water quality (small increases in turbidity) would occur, primarily during construction, but are not expected to decrease DO concentrations or increase water temperatures. Pile driving noise would exceed the fish behavioral threshold during vibratory pile driving and be above behavioral and injury thresholds during impact pile driving in the action area that contains critical habitat. However, effects to these PCEs would be insignificant because pile driving would primarily use vibratory pile driving method, and would implement a soft-start approach.

As noted above in Sections 3.3.1.3.5, 3.3.1.3.6, and 3.3.1.3.7, bocaccio, yelloweye rockfish, and canary rockfish are rare in Hood Canal waters, as generally limited by the lack of suitable habitat. Construction of SPE Alternative 2 would result in small-scale changes in current velocity and flow around the in-water vessels. However, this effect would be too small and localized to alter existing nearshore currents or normal rockfish larval recruitment along the Bangor shoreline. SPE Alternative 2 construction activities may result in temporary and intermittent (over two in-water work seasons) offshore (>30 feet [9 meters] below MLLW) impacts on water quality (e.g., increased turbidity), minor and temporary decreases in prey availability, benthic habitat conversion and loss, temporarily elevated noise levels, and loss of non-eelgrass aquatic vegetation. This alternative would not cause a violation of state water quality standards or reduction in sediment quality (Section 3.1.2.3.2), based on adherence to appropriate water and sediment quality BMPs and current practices (Section 3.1.1.2.3).

Pile driving activities would increase underwater noise above the injury thresholds and behavioral guideline for fish in some areas. Fish occurring within the effects range (Figures 3.3-6b and 3.3–7b, respectively) for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012), although these responses may resolve soon after pile driving ceases (NMFS 2014b). As explained in NMFS (2012), it is unlikely these minor changes in behavior would preclude a fish from completing any normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable. Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment, vegetation, and prey base disturbance, and the avoidance and minimization measures described above and in Appendix C, any potential effects to bocaccio, canary rockfish, or yelloweye rockfish would be discountable. Any stressors that have the potential to affect designated critical habitat (e.g., water quality, substrate conditions) would be localized to the immediate vicinity of in-water construction, and would not reach proposed critical habitat. Underwater noise exceeding the behavioral threshold would reach critical habitat, but would only occur during active pile driving and would not alter designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

*NON-ESA-LISTED SALMONIDS*

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. Utilizing in-water work windows would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during this work window and result in limited exposure to construction activities.

*FORAGE FISH*

The only forage fish species with documented spawning habitat occurring along the Bangor shoreline is the Pacific sand lance (Section 3.3.1.5.3). At the SPE project site, Pacific sand lance spawning habitat has been documented along an estimated 1,650-foot (503-meter) length of the shoreline extending from the southern shoreline of Carlson Spit northward to the existing Service Pier causeway (Figure 3.3–4; WDFW 2013b). Temporary increase of suspended solids during pile driving and other in-water construction activities (two in-water work seasons) would be expected. However, due to strong nearshore currents and nearshore wind waves, the small portion of suspended fine sediments that would settle out of the water column onto intertidal beaches would not be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat near the SPE project site.

Forage fish that occur in the immediate project vicinity during in-water construction would be exposed to increased levels of turbidity. Based on recent nearshore beach seine data, it is reasonable to assume that forage fish, primarily sand lance, utilize the shoreline at the SPE project site. Therefore, forage fish could be present and potentially affected by construction activities. Impacts on nearshore vegetation and benthic communities from construction would be minimal, with no likely impacts on eelgrass (Section 3.2.2.3.2). In general, behavioral response including shoreline avoidance from visual stimuli of nearshore-occurring pre-spawn adult sand lance would not be expected from the offshore construction activity. Nighttime lighting associated with construction activities and daytime shadows cast from overwater structures and equipment could alter adult sand lance behavior, but the construction lighting occurs offshore, whereas adult sand lance spawn in intertidal habitats, away from the project activity and lighting. Halvorsen et al. (2012) determined that fish like sand lance that do not have swim bladders may be less susceptible to injury from simulated impact pile driving. Because all marine species are expected to avoid the immediate vicinity of in-water construction, potential impacts to sand lance are expected to be limited to minor behavioral disturbance.

*OTHER MARINE FISH SPECIES*

Marine fish species that are found near the project area share the same habitats as salmonids and, with a few exceptions, would experience similar project-related impacts from the construction of SPE Alternative 2. As described above, construction of SPE Alternative 2 is not anticipated to violate water or SQS in the project area.

Project impacts on physical habitat and barriers during construction would include an increase in the number of barges and activities in the vicinity of intertidal and subtidal habitats. However, non-salmonids and non-forage fish occurring along the Bangor waterfront generally do not exhibit similar shoreline migrations (Hart 1973; Wydoski and Whitney 2003). Although shiner perch migrate between nearshore and offshore habitats to bear their young in summer, and are one of the most abundant other marine fish species along the Bangor shoreline, shiner perch occur relatively infrequently at the SPE project site (SAIC 2006; Bhuthimethee et al. 2009). Since other species do not demonstrate similar migratory behavior as shiner perch, this alternative would generally not inhibit the migration of other marine species between nearshore and offshore habitats.

Benthic habitats used for marine fish foraging and rearing would be affected by construction activities (Section 3.2.2.3.2). Similar to salmonids, many non-salmonid fish species use forage fish as a food resource. As a result, any reduction in forage fish use of the site could reduce the local food resources of some non-salmonid fish species occurring in this area. Marine vegetation communities (<0.5 acre [0.2 hectare]) would also be affected during construction of SPE Alternative 2 (Section 3.2.2.3.2). Construction activities would potentially impact up to 3.9 acres (1.6 hectares) of benthic habitats. Potential impacts would be offset by actions summarized in the proposed compensatory aquatic mitigation plan (Appendix C, Section 6.0).

Some fish may avoid the area, particularly closer to the location of in-water work, or alter their normal behavior while in this area. However, studies have shown that some fish species may habituate to underwater noise (Feist 1991; Feist et al. 1992; Ruggerone et al. 2008) and would continue to occur within the behavioral disturbance zone (Figures 3.3–6b and 3.3–7b). These impacts would occur only during the in-water work window (July 15 to January 15). Upon completion of the pile driving effort, the underwater noise environment would return to pre-construction conditions.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

Marine habitats used by fish species that occur along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and manmade structures, such as piles used for cover. The primary impacts on marine fish from operation of SPE Alternative 2 would include an increase of overwater and in-water structures offshore of the primary juvenile salmonid migratory pathway, alteration of offshore habitats including some reduction in benthic community productivity, and an increase in offshore overwater shading. The following sections describe how each of these factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during operation of SPE Alternative 2.

Maintenance of SPE Alternative 2 would include routine inspections, cleaning, repair, and replacement of facility components (except pile replacement) as required. Measures described in Section 3.1.1.2.3 (water and sediment quality BMPs and current practices) would be employed to prevent discharges of contaminants to the marine environment. As a result, maintenance activities are not anticipated to adversely affect marine fish.

*ESSENTIAL FISH HABITAT*

EFH, with few exceptions, would experience project-related impacts from operation of SPE Alternative 2 similar to those described below for salmonids (Section 3.1.2.3.2). Operation of SPE Alternative 2 would not affect the long-term water and sediment quality in the project area (Section 3.1.2.3.2).

Long-term impacts on physical habitat and barriers would include an increase in overwater and in-water structures. The shading of offshore benthic habitats would be expected to result in a corresponding loss in habitat productivity, but would be minimized by the depth of the new structure (Section 3.2.2.3.2). The added artificial lighting would occur over deeper water and have little or no effect on EFH utilized by migratory species of nearshore fish, such as forage fish and juvenile salmon. While the habitat utilized by some fish species (e.g., starry flounder and English sole) would experience a reduction in flat benthic habitat, other habitats would be created and utilized by fish species that prefer more structured habitat (e.g., greenling and cabezon). The in-water structures would occur offshore of the primary juvenile salmonid migratory pathway and not represent a long-term nearshore migration barrier. Based on these impacts, a determination was made that operation of the SPE under Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

*THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN*

*ESA-Listed Hood Canal Salmonids*

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Operation of the SPE under Alternative 2 would have little or no impact on localized temperature, salinity, DO, or turbidity (Section 3.1.2.3.2). Waterfront vessel activity would increase slightly relative to existing conditions, but not sufficient in scale to alter local water or sediment quality. Operation of SPE Alternative 2 would be consistent with existing practices along the Bangor waterfront, with limited potential to degrade water quality (Section 3.1.2.3.2). SPE Alternative 2 would implement BMPs to minimize spill risks (Section 3.1.2.3.2), including accidental releases of fuel, sewage or oil wastes, explosives, cleaning solvents, munitions, or other contaminants that would impact water quality in Hood Canal. Stormwater from the SPE project site would be collected in a trench drain on the pier, treated using an in-line canister system designed to meet the basic treatment requirements of the WDOE *Stormwater Management Manual for Western Washington* (WDOE 2014), and then discharged to Hood Canal in accordance with an NPDES permit. Therefore the SPE structure would not represent a source of substantial pollutant loadings to Hood Canal.

Changes in sediment grain size would only be anticipated in the immediate vicinity of the pier extension, with little or no change in sediment characteristics beyond the footprint. Because sediments within the project area are considered uncontaminated, small-scale changes in local sediment accretion and erosion during operation of SPE Alternative 2 would not degrade existing conditions.

Physical Habitat and Barriers

As described for construction, approximately 230 36-inch (90-centimeter) and 50 24-inch (60-centimeter) steel pipe support piles would be driven to support the pier extension, and approximately 105 18-inch (45-centimeter) square concrete piles would be driven to serve as fender piles. The pier length would occur parallel to, and largely offshore of, the nearshore juvenile salmonid migratory pathway, defined as occurring from 12 feet (4 meters) above MLLW to 30 feet (9 meters) below MLLW.

Operation of SPE Alternative 2 would include an increase of overwater and in-water structures and artificial lighting offshore of the primary juvenile salmonid migratory pathway. Since these structures occur in more offshore waters of at least 30 feet below MLLW, the presence of these structures, the associated artificial lighting, and the shade they would cast, is not anticipated to alter the behavior of juvenile salmonids using the nearshore migratory pathway. Replacing the existing wave screen on the shoreward side of Service Pier with a similar-sized wave screen under the SPE is unlikely to adversely affect fish migration relative to existing conditions. The new wave screen would be located further offshore and outside the nearshore migration pathway of juvenile salmonids than the existing wave screen (Figure 2–10). Because most species of adult salmonids are less dependent on nearshore habitats and also have much greater mobility, these age classes would not experience a substantial barrier effect and there would be little or no overall delay in their movements. However, for those adult salmonids that have the potential to encounter in-water piles supporting the SPE structure, due to the large space between piles, they are anticipated to experience little or no overall delay during their return migration to spawn in Hood Canal streams. Little or no increase in predation risk of adult salmonids from marine mammals is anticipated from the operation of SPE Alternative 2.

Biological Habitat

*Prey Availability.* SPE Alternative 2 would result in increases of shaded marine habitat (Section 3.2.2.3.2). However, as described above for Marine Vegetation, there would be no long-term operational shading of existing marine vegetation (Section 3.2.2.3.2). The long-term presence of the piles supporting the pier extension would alter foraging habitats for marine fish that currently utilize the SPE location. Shading of the benthic community and the change from flat-bottom to structured habitat could alter the benthic community and productivity at the SPE project site (Section 3.2.2.3.2). The presence of the SPE is unlikely to result in adverse effects on forage fish migration, prey base, and Pacific sand lance spawning along the nearshore habitats, and is not expected to decrease occurrence in the vicinity of the Service Pier.

*Aquatic Vegetation.* The extension of the Service Pier under Alternative 2 would add approximately 44,000 square feet (4,090 square meters) of overwater structure to the end of the existing pier (Section 2.3.2.2). Shading impacts of aquatic vegetation would not occur because the pier extension would be located in water depths of 30 feet (9 meters) below MLLW or deeper, beyond the depths where marine vegetation occurs in this area (Section 3.2.2.3.2). As a result, the presence of SPE Alternative 2 is not expected to reduce aquatic vegetation available to juvenile salmon or other marine fish species migrating along the Bangor shoreline.

Underwater Noise

Operation of SPE Alternative 2 may result in small increases in underwater noise relative to existing conditions may occur from activities on the pier, including cranes, generators, compressors, or other machinery. However, this increase is not expected to be discernable from existing variations in ambient noise.

Summary of Impacts and ESA-Listed Salmonids Determination

Due to the offshore location of the pier extension, the operation of SPE Alternative 2 would have little effect on habitats within the nearshore migratory pathway used by juvenile salmonids. SPE Alternative 2 would include an increase in offshore overwater and in-water structures and artificial lighting, but these increases would be limited compared to the availability of habitat and resources in Hood Canal. Due to offshore shading and the presence of piles where they currently do not exist, a minor shift in benthic community and productivity may occur. However, little or no change in the nearshore presence of, and habitat utilization by, forage fish, including sand lance spawning is anticipated since these species already inhabit areas adjacent to prior construction and infrastructure improvements. Significant changes in behavior or delays in migration are not anticipated. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats. Therefore, the effect determination for all listed salmonid species is “may affect, not likely to adversely affect.” The effect determination for critical habitat is also “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect).

*ESA-Listed Hood Canal Rockfish*

Rockfish Habitat Requirements

Currents

As discussed above for salmonids, due to the presence of the piles, operations under SPE Alternative 2 would have minor and local effects on water flow in the immediate vicinity of the piles. There would be an increase in turbulent flow in the immediate vicinity of the SPE and a decreased flow immediately downstream (Section 3.1.2.3.2). However, these changes would be small scale and localized to the immediate vicinity of in-water components of each pier structure. The overall flow of water in deeper water areas adjacent to the pier would not be impeded by the extension. As a result, due to the limited and localized scale of project effects on currents, the operation of SPE Alternative 2 would not modify currents at a scale that would affect rockfish recruitment within northern Hood Canal waters.

Water Quality

As discussed above for salmonids, operation of SPE Alternative 2 would not affect existing DO levels in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. In addition, due to the general maintenance of existing flow conditions, operation of the pier extension would not result in water temperature increases over existing conditions, and would not elevate levels of suspended solids sufficient to degrade water quality (Section 3.1.2.1.2.2).

Habitat Alteration

Rockfish habitat alteration can cause three interrelated stressors identified by Palsson et al. (2009) and Drake et al. (2010), including loss of suitable habitat, competition, and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

*Suitable Habitat.* Very little loss of marine vegetation, as potentially used for juvenile rockfish recruitment, would occur due to displacement from the project footprint and associated overwater shading from the proposed structures. At some tidal elevations, shade-related effects would generally occur away from the shoreline since the additional overwater structures from the pier extension would occur at depths of 30 feet (9 meters) below MLLW or greater. Operations would not be expected to inhibit kelp growth because no attached, canopy-forming kelp beds occur along the Bangor waterfront (Section 3.2.1.1.2).

New piles to be installed could serve as post-larval juvenile rockfish recruitment habitat. In Hood Canal, suitable structured habitat for rockfish recruitment is very limited (PSAT 2007a; Palsson et al. 2009), with existing marine reserves accounting for almost 20 percent of the available nearshore rocky habitat (PSAT 2007a). Suitable habitat is limited between NAVBASE Kitsap Bangor and the Toandos Peninsula. WDFW conducted 24 trawls in this vicinity and did not capture any of the three ESA-listed rockfish (Palsson 2009, personal communication). The lack of suitable recruitment habitat in Hood Canal largely contributes to the patchy and limited distribution and abundance of rockfish in Hood Canal. Although there are substantial difficulties comparing the loss of marine vegetation to the addition of manmade structures as habitat for juvenile rockfish recruitment, it is likely that the loss of marine vegetation habitat is offset, to some degree, by the addition of structured habitat. Whether the change in habitat type would be a net benefit or detriment to rockfish is unknown.

*Predation.* The same piles that could serve as a potential recruitment benefit to juvenile bocaccio, yelloweye rockfish, and canary rockfish could also serve as habitat for rockfish predators (e.g., lingcod and larger sub-adult and adult rockfish). Baskett et al. (2006) found that, prior to commercial fishing pressure, predation and competition shaped the rockfish community structure. This was primarily due to rockfish intra-guild predation, including large adult rockfish preying on smaller rockfish members, as well as predation by lingcod. Beaudreau and Essington (2007, 2009) found that rockfish comprise 11 percent of adult lingcod diet by mass. These studies showed that in structured habitats protected from fishing (i.e., marine reserves), lingcod can limit the prevalence of rockfish through predation. The average size and abundance of lingcod in the existing NAVBASE Kitsap Bangor pier habitats is unknown, but the pier extension associated with this alternative would result in increased predator habitat and potential predation on juvenile rockfish. Further, it is unknown if the benefit of these structures for suitable recruitment habitat would be equivalent to any potential loss of juvenile rockfish to predators.

*Competition.* Habitat modification due to the pier extension of this alternative would result in a benthic-to-structure community shift and may create habitat that is more suitable for one species of rockfish compared to others. As noted above, juvenile rockfish can occur in shallow nearshore waters over rocks with algae or in sandy areas with eelgrass or drift algae. The presence of the more structured habitat may promote competition with species that use these habitat types for recruitment and rearing. Whether the existing benthic habitat or the proposed structured habitat would be more beneficial to rockfish is unknown.

Palsson et al. (2009) note that, in the absence of fishing pressure, the more aggressive copper and quillback rockfish species appear to limit the prevalence of brown rockfish. Both of these rockfish species appear to be more prevalent in Hood Canal waters than any of the three ESA-listed rockfish species and may out-compete other rockfish species for the limited structured habitat. Therefore, due to natural factors including intraguild competition, an increase in suitable structured habitat would not necessarily result in a corresponding increase of listed rockfish abundance in the project area.

*Prey Availability.* Since operation of SPE Alternative 2 would not decrease the local abundance or distribution of plankton along the Bangor shoreline (Section 3.2.2.3.2), larval bocaccio, yelloweye rockfish, and canary rockfish would not experience a decrease in food availability. The in-water structures would reduce the size and suitability of some habitats, notably marine vegetation used by forage fish and shiner perch (juvenile/sub-adult rockfish food resources). However, the piles would provide structure used by other potential prey base species, including the invertebrate fouling community, crabs, juvenile rockfish, perches, sculpins, and greenling (Hueckel and Stayton 1982; Nightingale and Simenstad 2001a; Love et al. 2002). Whether the small local shift in community type would have a corresponding effect on rockfish is unknown.

Due to the construction and operation of the pier extension under SPE Alternative 2, benthic-obligate juvenile rockfish prey within the immediate project vicinity could decrease in abundance, whereas structure-dependent juvenile rockfish and their associated prey organisms could increase. It is not known which of these effects would be greater.

*Exotic Species.* Operation of the SPE Alternative 2 would not introduce exotic species from foreign water bodies or increase the prevalence of existing exotic species in Hood Canal waters. Further, operation of SPE Alternative 2 would not create chronic disturbances that would facilitate colonization by nonindigenous species. Therefore, operation of this alternative is not anticipated to facilitate the spread or prevalence of exotic organisms along the Bangor shoreline, or the Hood Canal basin.

Underwater Noise

As discussed above for salmonids, operation of SPE Alternative 2 would increase vessel activity relative to existing conditions and, therefore, could slightly increase vessel-related underwater noise. A small increase in underwater noise would occur from increased activities on the pier such as cranes, generators, compressors, or other machinery.

Summary of Impacts and ESA-Listed Rockfish Determination

As detailed in the sections above, operation of SPE Alternative 2 would not result in long-term adverse impacts on water quality (Section 3.1.2.3.2) or increase the prevalence of exotic species. Bocaccio, yelloweye rockfish, and canary rockfish are extremely rare in Hood Canal waters. The structure-supporting piles would convert existing soft-bottom benthic habitat to a habitat with in-water structures that could affect local prey availability, as well as the potential to increase recruitment of juvenile bocaccio, yelloweye rockfish, canary rockfish, and rockfish competitors and predators. However, based on the low likelihood of occurrence in the project area, these effects would be discountable, and no population-level impacts are anticipated. No operational stressors associated with the proposed project are anticipated in designated critical habitats. Therefore, the effect determination for all listed rockfish species and their critical habitats is “may affect, not likely to adversely affect.”

*NON-ESA-LISTED SALMONIDS*

Impacts described above for ESA-listed salmonids due to operation of SPE Alternative 2 would be similar for other salmonids potentially occurring in the project area.

*FORAGE FISH*

Operation of SPE Alternative 2 would have little or no impact on surf smelt or Pacific herring spawning habitats or their reproductive success because no documented surf smelt or Pacific herring spawning grounds occur along the 4.3-mile (7-kilometer) long Bangor waterfront (Penttila 1997; Stout et al. 2001; WDFW 2013b; NAVFAC Northwest 2014). However, Pacific sand lance spawning occurs shoreward of the pier extension site (Figure 3.3–4, Section 3.3.1.5.3) (WDFW 2013b). The presence of in-water structures and the impacts affecting juvenile and adult forage fish behavior would be similar to those described above for salmonids. Though further offshore, the small increase in vessel activity, and associated wakes, in close proximity to the nearby 1,650-foot (503-meter) documented Pacific sand lance spawning, could have a minor effect on the distribution and behavior of adult and larvae in the immediate project vicinity.

In a review of sand lance biology, Robards et al. (1999) found that some studies indicate sand lance behavior is strongly tied to food availability, water temperatures, and light intensity, including artificial nighttime lighting. Due to attraction, artificial lighting could result in minor delays or alteration of forage fish migration, similar to salmonids. In addition, the presence of artificial light could increase nighttime predation of forage fish. Nearshore vessel activity associated with the new structure would increase slightly over existing conditions. Additionally, localized distribution of the plankton community (the primary forage fish food resource) may take place, but these species would continue to occur in the project vicinity (Section 3.2.2.3.2).

*OTHER MARINE FISH SPECIES*

With a few exceptions, marine fish species that are found near the project area share the same habitats as salmonids and would experience project-related impacts from operation of SPE Alternative 2 that would be similar to those described for salmonids, forage fish, and rockfish. As summarized above for these species, operation of SPE Alternative 2 would not affect water and sediment quality in the project area (Section 3.1.2.3.2).

Project impacts on physical habitat would include an increase of overwater and in-water structures in offshore habitats. The presence of these structures would result in localized decreases in currents around the piles. The combination of shading of benthic habitats and the change from soft-bottom benthic to structured habitats (e.g., piles) would be expected to result in a corresponding change in benthic community composition. That could lead to a corresponding change in available benthic food resources for some fish species. While some fish species (e.g., flatfish including starry flounder and English sole) could experience a reduction in flat benthic habitat suitable for their life history, others (e.g., pile perch and greenling) would experience an increase in habitat suitable for their life history (Hart 1973). Operations are not expected to result in the loss through shading of aquatic vegetation and, therefore, are not expected to decrease habitat values for fish dependent on vegetation.

As discussed for construction, the presence of offshore structures would not represent a migration barrier to nearshore migrating juvenile salmonids and forage fish. Larger salmonids that migrate in offshore waters may encounter these structures, but would be able to migrate through or around them with little or no overall delay in migration. However, few other species occurring along the Bangor waterfront exhibit shoreline migration patterns similar to those of salmonids (Hart 1973). For example, shiner perch, the most abundant non-salmonid or forage fish captured in these waters (SAIC 2006; Bhuthimethee et al. 2009), overwinter in deeper offshore waters and migrate into nearshore waters in the spring to bear their young (Hart 1973). However, since shiner perch are relatively absent in the project area, and the SPE would be oriented parallel to shore, operation of this alternative would have little or no impact on the movement of this or other non-salmonid or forage fish species.

#### 3.3.2.3.3. SPE ALTERNATIVE 3: LONG PIER

CONSTRUCTION OF SPE ALTERNATIVE 3

As described below, there are some differences in construction-related impacts between SPE Alternatives 2 and 3, including a longer pier configuration, a larger overwater structure, and more support and fender piles required for SPE Alternative 3 compared to Alternative 2. In general, however, the impacts on habitats utilized by marine fish (water and sediment quality, physical habitats, biological habitats, and underwater noise) would be similar for both alternatives.

*ESSENTIAL FISH HABITAT*

Impacts on EFH from the construction of SPE Alternative 3 would be similar to those described for SPE Alternative 2. However, differences include a greater number of piles (approximately 660 vs. 385) and a larger overwater structure (70,000 vs. 44,000 square feet) for SPE Alternative 3 than for Alternative 2. There would be a larger area of potential construction impacts on water quality and benthic EFH for SPE Alternative 3 than for Alternative 2 (6.6 versus 3.9 acres [2.7 versus 1.6 hectares]). Further, additional days of pile driving would be necessary under SPE Alternative 3 compared to Alternative 2 (up to 205 vs up to 161, respectively), but would still only require two in-water work seasons. These differences would not substantially increase or decrease project-related impacts on EFH, and overall effects would be similar to those described for SPE Alternative 2. Construction of the SPE may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

*THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN*

*ESA-Listed Hood Canal Salmonids*

<u>Salmonid Marine Habitat Conditions</u>

<u>Water and Sediment Quality</u>

Construction-related impacts from SPE Alternative 3 on water and sediment quality would be similar to those for SPE Alternative 2 (Sections 3.2.2.1.1 and 3.3.2.1.1). Although SPE Alternative 3 would involve a larger number of piles and more in-water work days for the construction of the longer pier extension, the fish window precludes in-water construction occurring at a time when juvenile salmonids would be prevalent. Therefore, project-related effects on nearshore water and sediment quality used by salmonids under SPE Alternative 3 would be similar to what is described for Alternative 2.

<u>Physical Habitat and Barriers</u>

SPE Alternative 3 physical habitat effects also would be similar to those described for SPE Alternative 2. The replacement of the existing wave screen with a new wave screen would be the same for both alternatives. However, a larger number of piles would be driven during construction of the longer pier extension, requiring more days of pile driving than SPE Alternative 2. Construction activity would not occur directly in the nearshore migratory pathway for juvenile salmonids (water depths less than 30 feet [9 meters]). However, due to the proximity of the project site to the migratory pathway, and that the construction disturbance extends beyond the footprint into the pathway, barrier impacts on nearshore salmonids would occur and include construction activity, lighting of the construction area and construction platforms, vessel shading, barge anchoring and anchor dragging, underwater noise, localized, temporary plumes of increased suspended solids produced during pile-driving, and anchoring activities that would occur over two in-water work seasons. Older age classes of salmon have much greater mobility, and are unlikely to experience the same shallow water barrier effects as nearshore-dependent juvenile salmonids. Because these minor differences would not substantially increase or decrease project-related impacts to marine fish, the overall effects on these species would be similar to those described for SPE Alternative 2.

Biological Habitat

The longer pier extension of SPE Alternative 3 would occur outside of the nearshore migratory pathway for juvenile salmonids, similar to SPE Alternative 2. As a result, impacts on the nearshore benthic community and aquatic vegetation (Section 3.2.2.3.2) used by juvenile salmonids and forage fish would also be the same. Larger juvenile salmonids (e.g., Chinook and coho) and adult salmonids migrate further offshore in the neritic zone, and are generally less dependent on benthic invertebrates. However, should they utilize these resources in the project footprint these salmonids may experience some loss of available benthic prey. The increase in the number of piles driven under SPE Alternative 3 is not expected to introduce or increase the prevalence of exotic species to Hood Canal waters. Therefore, other than increased exposure to underwater noise from additional pile driving days, impacts on nearshore biological habitats used by salmonids under SPE Alternative 3 would be similar to that described for SPE Alternative 2.

Underwater Noise

For underwater noise effects on ESA-listed fish, the greatest difference between Alternatives 2 and 3 would be the number of piles to be driven, the in-water construction duration, and distance from shore for in-water work.

Table 3.3–7 and Figures 3.3–8a though –9b illustrate the distances at which underwater noise from pile driving could exceed the behavioral guideline and injury thresholds for fish during construction under SPE Alternative 3.

**Table 3.3–7. SPE Alternative 3 Fish Threshold and Guideline Levels and Effect Ranges for the Operation of Impact Hammer and Vibratory Pile Drivers**

| Fish Threshold and Guideline Levels[1,2] | SPE Alternative 3 Effect Ranges | |
|---|---|---|
| | First In-Water Work Window | Second In-Water Work Window |
| | 24-inch Steel Piles[3] | 18-inch Concrete Piles |
| **206 dB peak, impact hammer (injury)** | 18 feet (5 meters) | 1 foot (< 1 meter) |
| **187 dB SEL (injury to fish ≥ 2 g)** | 607 feet (185 meters) | 92 feet (28 meters) |
| **183 dB SEL (injury to fish < 2 g)** | 1,122 feet (342 meters) | 171 feet (52 meters) |
| **150 dB RMS, impact hammer (behavioral for all fish)** | 7,068 feet (2,154 meters) | 707 feet (215 meters) |
| **150 dB RMS, vibratory driver (behavioral for all fish)** | 178 feet (54 meters) | n/a |

dB = decibel; g = gram; RMS = root mean square; SEL = Cumulative Sound Exposure Level

1. Underwater noise thresholds are taken from Fisheries Hydroacoustic Working Group (2008).
2. The underwater noise guideline for behavior is taken from Hastings (2002).
3. An 8 dB reduction in sound pressure levels is incorporated in range estimate.

<u>Summary of Impacts and ESA-Listed Salmonid Determination</u>

Construction-related impacts of SPE Alternative 3 on NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be similar to those described for SPE Alternative 2, although they would be somewhat greater due to a longer duration of pile driving and more in-water piles.

Fish occurring within the effects range (Table 3.3–7 and Figures 3.3–8b and –9b) for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012), although these responses may resolve soon after pile driving ceases (NMFS 2014b). As explained in NMFS (2012), it is unlikely these minor changes in behavior would preclude a fish from completing any normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable. Any stressors that have the potential to affect critical habitat PCEs (e.g., disturbed sediments) would be highly localized to the immediate vicinity of in-water construction, and would not reach proposed or designated critical habitat. Therefore, the effect determination for all listed salmonid species is “may affect, not likely to adversely affect.” The effect determination for critical habitat is also “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect).

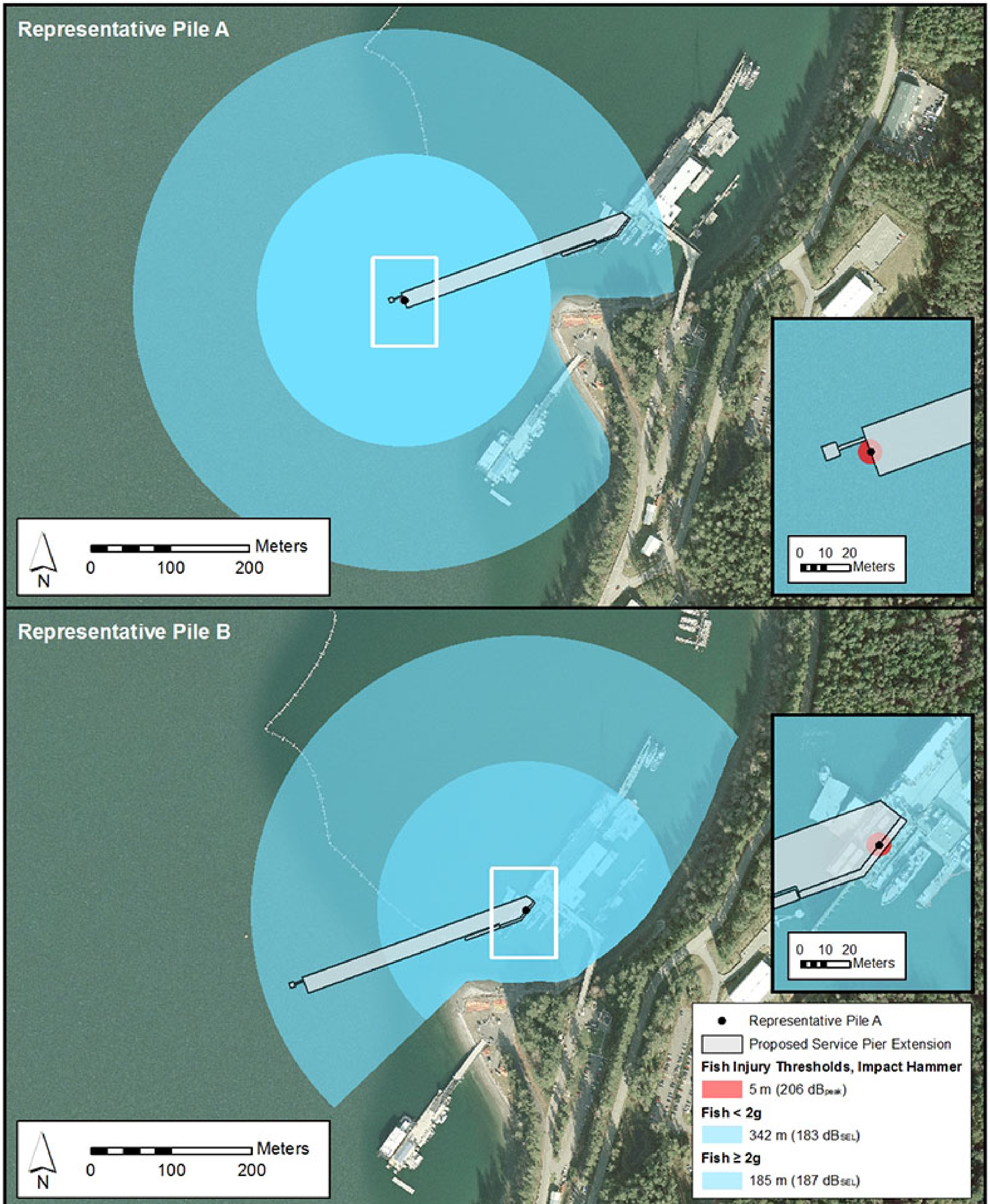


**Figure 3.3-8a. Representative View for Fish Injury Threshold due to 24-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 3**

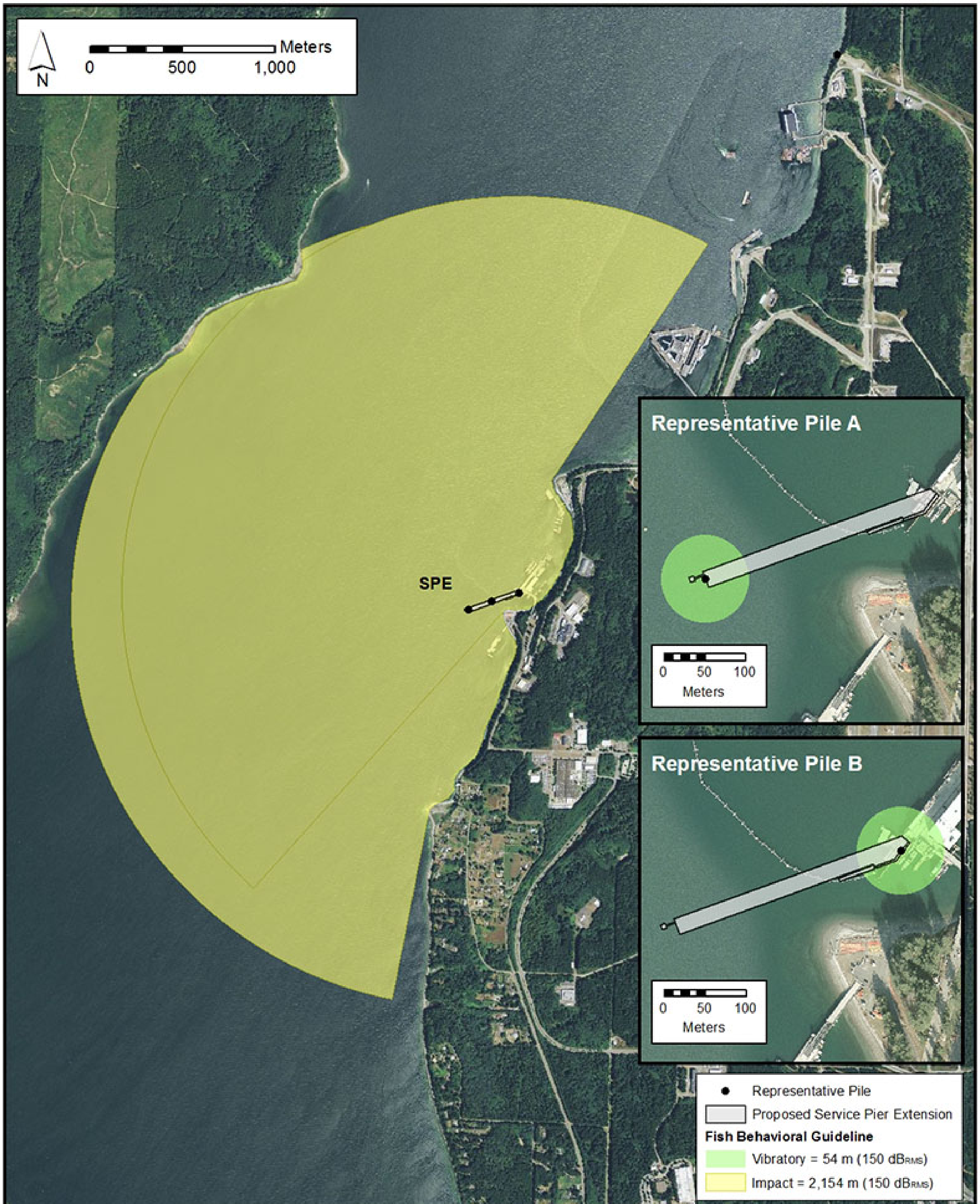


**Figure 3.3-8b. Representative View for Fish Behavioral Guideline due to 24-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 3**

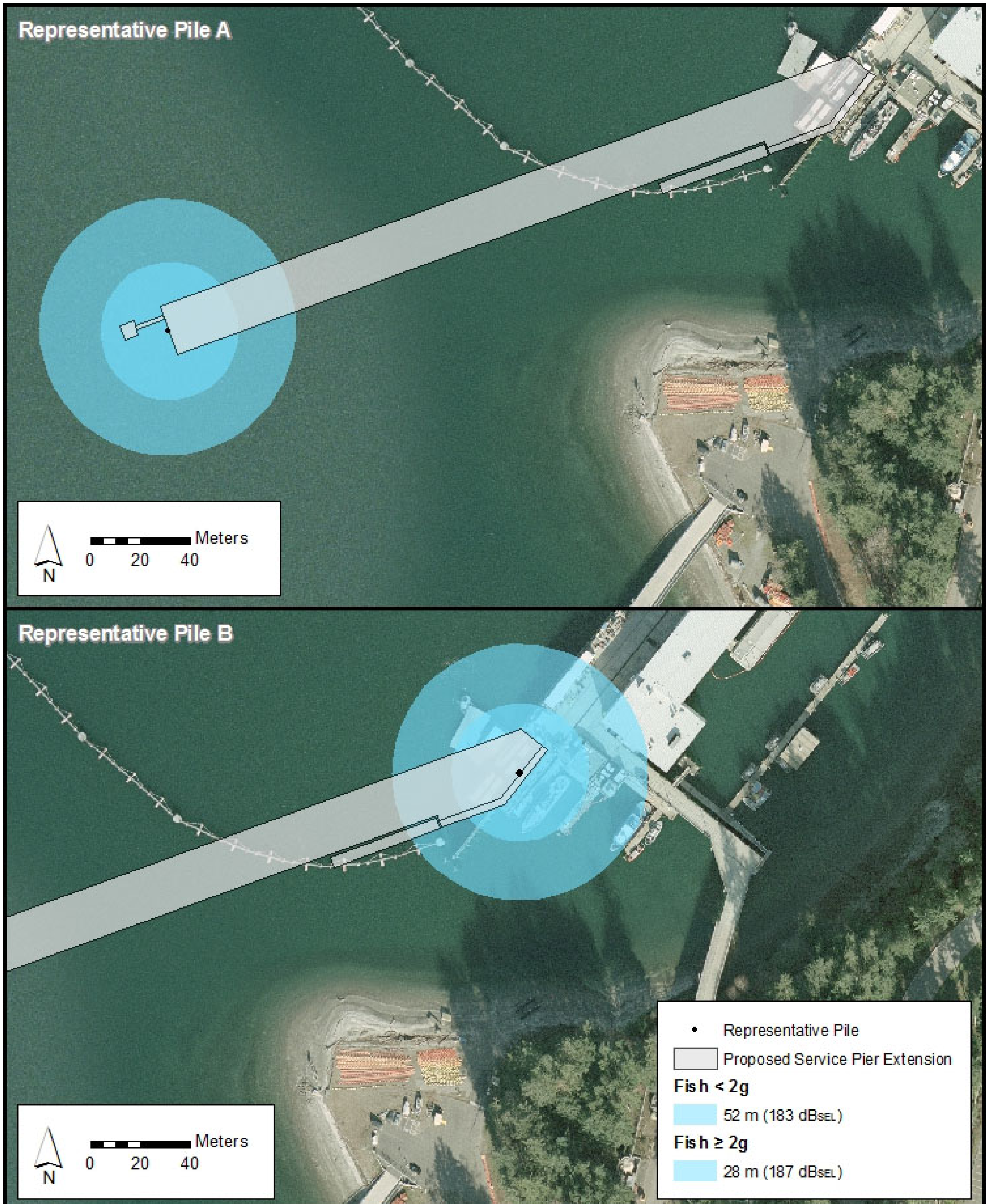


**Figure 3.3-9a. Representative View for Fish Injury Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 3**

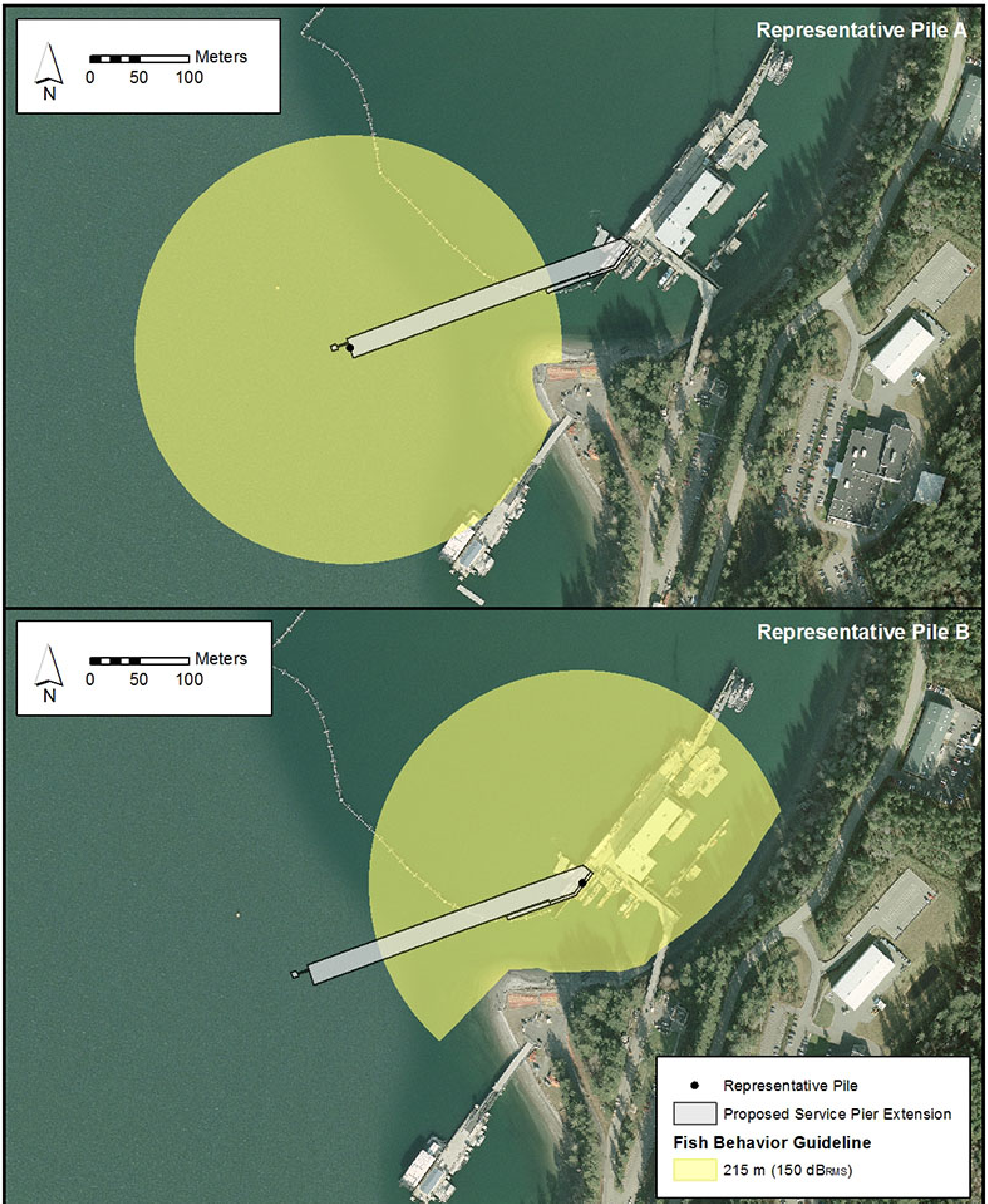


**Figure 3.3-9b. Representative View for Fish Behavioral Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 3**

*ESA-Listed Hood Canal Rockfish*

Impacts on currents, water quality, and habitats during the construction of SPE Alternative 3 would be similar to those described for SPE Alternative 2. The greatest differences between the alternatives would be more piles, more pile driving days, and more overwater structure for SPE Alternative 3. In addition, SPE Alternative 3 would involve a longer duration of in-water work and a larger footprint impact on benthic habitats from construction activities. However, these differences would be insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for SPE Alternative 2. Any stressors that have the potential to affect critical habitat PCEs (e.g., water quality, substrate conditions) would be highly localized to the immediate vicinity of in-water construction, and would not reach designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

*NON-ESA-LISTED SALMONIDS*

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. Complying with the permitted in-water work window would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during this work window and resulting limited exposure to construction activities. However, due to a greater number of piles required, and the associated increase in pile driving time for SPE Alternative 3 compared to SPE Alternative 2, SPE Alternative 3 would have slightly greater impacts on habitat use, distribution, and migration of non-ESA-listed salmonids along the Bangor shoreline.

*FORAGE FISH*

Impacts on forage fish due to construction of SPE Alternative 3 would be similar to those described for SPE Alternative 2. Because the total number of piles for SPE Alternative 3 would be greater than for SPE Alternative 2, the number of days forage fish would experience elevated noise levels would similarly increase. However, similar to SPE Alternative 2, other than underwater noise impacts, SPE Alternative 3 would have little effect on the occurrence of forage fish occurring along the shoreline.

*OTHER MARINE FISH SPECIES*

Impacts on other marine fish species from SPE Alternative 3 would be similar to those described for SPE Alternative 2. However, differences would include a larger number of piles for construction of the longer pier extension and additional days of pile driving for SPE Alternative 3. These differences would not substantially increase or decrease SPE Alternative 3 project-related impacts on other marine fish species and the overall effects on these species would be similar to those described for SPE Alternative 2.

OPERATION/LONG-TERM IMPACTS

Maintenance of the pier extension under SPE Alternative 3 would have similar impacts on marine fish as SPE Alternative 2. Measures noted above would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect marine fish.

*ESSENTIAL FISH HABITAT*

Operational impacts on EFH from the operation of SPE Alternative 3 would be similar to those described for SPE Alternative 2. The total overwater area would be greater for SPE Alternative 3 than for Alternative 2. Additional differences would include a larger number of piles for SPE Alternative 3. Minor differences between alternatives would not substantially increase or decrease operational impacts on EFH. Therefore, since the overall effects of SPE Alternative 3 would be similar to those described for SPE Alternative 2, operation of SPE Alternative 3 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

*THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN*

*ESA-Listed Hood Canal Salmonids*

Marine Salmonid Habitat Conditions

Water and Sediment Quality

Long-term impacts on water and sediment quality (Section 3.1.2.3.3) from operation of SPE Alternative 3 would be the same as noted for SPE Alternative 2. Therefore, the operation of SPE Alternative 3 would not result in degraded water or sediment quality in habitats used by salmonids.

Physical Habitat and Barriers

The longer pier extension for SPE Alternative 3 would include more piles than SPE Alternative 2. However, the longer extension under SPE Alternative 3 would occur offshore of the nearshore juvenile salmonid migratory pathway, and would not increase barriers in this pathway, similar to conclusions for SPE Alternative 2. Because most species of adult salmonids are less dependent on nearshore habitats and also have much greater mobility, these age classes would also not experience a substantial barrier increase under SPE Alternative 3 compared to SPE Alternative 2.

Biological Habitat

Operational impacts on benthic productivity (Section 3.2.2.3.3) from SPE Alternative 3 would be similar to those described for SPE Alternative 2. The depth of the overwater structures would be sufficient such that no long-term impacts on aquatic vegetation are anticipated (Section 3.2.2.3.3). Similar to the design of the shorter pier under SPE Alternative 2, the long pier extension of SPE Alternative 3 would occur offshore of intertidal and shallow subtidal habitats, so potential effects on forage fish spawning habitats, nearshore habitat use, and migration would also be the same (Section 3.3.2.2.2).

Underwater Noise

Due to the same level of vessel and pier activity under each alternative, with the greatest difference being the location of this activity, underwater noise generated during the operation of SPE Alternative 3 would be similar to SPE Alternative 2.

Summary of Impacts and ESA-Listed Salmonids Determination

The operational effects of SPE Alternative 3 on nearshore NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be slightly greater for SPE Alternative 3 compared to Alternative 2. The long pier extension of SPE Alternative 3 would include an increase in overwater coverage and in-water piles compared to SPE Alternative 2. However, these increases would occur in deeper water habitats, away from the nearshore juvenile salmonid migratory pathway. These differences would neither increase or decrease species level threshold or habitat effects, and the SPE Alternative 3 effect determination on threatened and endangered fish species would be the same as described for SPE Alternative 2. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

*ESA-Listed Hood Canal Rockfish*

Similar to the conclusions noted above for operation of SPE Alternative 2, operation of SPE Alternative 3 would not result in adverse impacts on currents at a scale that would affect larval retention, water quality, or increase the prevalence of exotic species. Underwater noise from vessel operations is not anticipated to rise to a level that would limit rockfish occurrence. The greatest difference between the two alternatives would be the increase in overwater structures (70,000 vs. 44,000 square feet) and in-water piles (approximately 660 vs. 385) for SPE Alternative 3. Although the number of piles would increase for this alternative, this difference is considered insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for SPE Alternative 2. No operational stressors associated with the proposed project are anticipated in designated critical habitats. Therefore, the effect determination for all listed rockfish species is "may affect, not likely to adversely affect."

*NON-ESA-LISTED SALMONIDS*

Potential impacts described above for ESA-listed salmonids due to operation of SPE Alternative 3 would be similar for other salmonids. The long pier extension of SPE Alternative 3 would include an increase in overwater coverage and in-water piles compared to SPE Alternative 2. However, these increases would occur in deeper water habitats. Therefore, operation of SPE Alternative 3 may result in minor impacts to the habitat use and movement of non-ESA-listed salmonids through the project area. However, these impacts are not expected to be of a scope or intensity that would their overall distribution and abundance.

*FORAGE FISH*

Because the effects on nearshore water and sediment quality, physical habitat, biological habitat, and underwater noise for both SPE Alternative 2 and 3 would be similar, operational impacts on forage fish from SPE Alternative 3 would also be similar to those described for SPE Alternative 2. Since the pier extensions for both alternatives would occur offshore, away from the nearshore forage fish migratory pathway and intertidal Pacific sand lance spawning habitat, potential effects on forage fish spawning habitats, nearshore habitat use, and migration would also be limited. Similar to SPE Alternative 2, minor effects could occur from operation of SPE Alternative 3 as a result of increased vessel activity, and associated wakes in close proximity to the nearby 1,650-foot (503-meter) documented Pacific sand lance spawning habitat, and artificial lighting that could result in minor delays or alteration of forage fish migration.

*OTHER MARINE FISH SPECIES*

Operational impacts on other marine fish species for SPE Alternative 3 would be similar to those described for salmonids and other marine fish species for SPE Alternative 2. Differences would include a larger overwater structure and an increase in the number of piles under SPE Alternative 3. There would be some minor reductions in benthic productivity from shading and a greater alteration of flat-bottomed habitat to structured habitat due to the presence of the piles. Neither alternative would result in widespread impacts to aquatic vegetation (Sections 3.2.2.3.2 and 3.2.2.3.3), or water and sediment quality in the project area (Section 3.1.2.3.3). Although minor localized shifts in fish use are likely due to the presence of piles, the differences summarized above would not substantially increase or decrease operational impacts on other marine fish species, so the overall effects of SPE Alternative 3 on these species would be similar to those described for SPE Alternative 2.

#### 3.3.2.3.4. SUMMARY OF SPE IMPACTS

Impacts on fish during the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.3–8.

### Table 3.3–8. Summary of SPE Impacts on Fish

| Alternative | Environmental Impacts on Fish |
|---|---|
| SPE Alternative 1: No Action | No impact. |
| SPE Alternative 2: Short Pier (Preferred) | *Construction:* Temporary degradation of turbidity and nearshore physical barriers and habitat; temporary decrease in function of habitats and aquatic vegetation used for foraging and refuge. Underwater noise thresholds for injury and guideline for behavioral disturbance would be exceeded during pile driving (this action would only occur during in-water work windows when juvenile salmon are generally not present). Potential disturbance of only small areas of marine vegetation due to the deep water occurrence of the project.<br>*Operation/Long-term Impacts:* Localized changes in fish habitat type from benthic to structured habitats in the project footprint, waters deeper than 30 feet (9 meters) below MLLW, with little or no barrier effect on juvenile and adult migratory fish. |
| | *ESA:* Alternative 2 "may affect, not likely to adversely affect" Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).<br>*EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. |
| SPE Alternative 3: Long Pier | *Construction:* Temporary degradation of turbidity and nearshore physical barriers and habitat; temporary decrease in the function of habitats and aquatic vegetation used for foraging and refuge. SPE Alternative 3 would exceed underwater noise thresholds for injury and the behavioral disturbance guideline for fish during pile driving (this action would only occur during in-water work windows when juvenile salmon are generally not present), for up to 44 days longer than for SPE Alternative 2. Potential disturbance of only small areas of marine vegetation due to deep water occurrence of the project. |
| | *Operation/Long-term Impacts:* SPE Alternative 3 would have approximately 275 more piles than Alternative 2 and would result in greater localized changes in fish habitat type from benthic to structured habitats in the project footprint, waters deeper than 30 feet below MLLW, with little or no barrier effect on juvenile and adult migratory fish. SPE Alternative 3 would create 26,000 sq ft more offshore overwater structure than SPE Alternative 2, potentially creating additional overwater shading effects on behavior of fish occurring in the area. |
| | *ESA:* Alternative 3 "may affect, not likely to adversely affect" Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).<br>*EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. |
| **Mitigation:** BMPs and current practices to reduce and minimize impacts on marine fish are described in Section 3.3.1.8.3. Under either alternative, proposed compensatory aquatic mitigation (Appendix C, Section 6.0) would compensate for the project's aquatic habitat impacts. | |
| **Consultation and Permit Status:** The Navy is addressing impacts on ESA-listed marine fish and MSA-covered habitats under consultation with the NMFS West Coast Region office under the ESA and MSA. An EFHA was submitted to the NMFS West Coast Region office on March 10, 2015. A BA was submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office on March 10, 2015 and a revised BA was submitted on June 10, 2015. In a concurrence letter dated March 4, 2016, USFWS stated that the SPE project impacts to bull trout are not measurable and therefore insignificant. Consultation under the ESA and MSA with NMFS is ongoing. | |

BMP = best management practice; EFH = Essential Fish Habitat; ESA = Endangered Species Act; MLLW = mean lower low water; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service.

### 3.3.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

#### 3.3.2.4.1. SALMONIDS

Construction of the LWI and SPE projects, separately and combined, is expected to result in temporary and localized water quality effects, including increased turbidity. However, long-term degradation of nearshore water quality or violations of state water quality standards that would affect salmonid occurrence (Table 3.3–9) are not anticipated. Although the proposed projects may result in localized changes in flow patterns, these combined changes are not expected to be of sufficient scale to affect salmonid migration or the use of suitable habitats. In addition, in-water construction activities would only occur during the in-water work window (except non-pile driving work for the LWI project), when nearshore juvenile salmonids are least abundant.

**Table 3.3–9. Summary of Combined LWI/SPE Impacts for Salmonids and Marine Fish**

| Resource | Combined LWI/SPE Impacts |
|---|---|
| **Impact** | |
| **Salmonids** | The combined effects of the LWI and SPE projects on salmonid habitats from construction would include increased turbidity and impacts to benthic and marine vegetated habitats and underwater noise, including up to 285 days of pile driving over four in-water work seasons. Long-term impacts to salmonid habitats would largely be minor and localized, with the exception of LWI Alternative 2, which may increase barriers to nearshore juvenile salmon migration, potentially resulting in highly localized, minor delays in migration and increased risk of predation. |
| **Other Marine Fish Species** | The combined effects of the LWI and SPE projects on habitats utilized by other marine fish species from construction would include increased turbidity and impacts to benthic and marine vegetated habitats and underwater noise, including up to 285 days of pile driving over four in-water work seasons. The long-term alteration of habitat may result in highly localized, minor changes in habitat use by non-salmonid marine fish species. |

Within habitats utilized by salmonids, construction of the LWI and SPE projects may result in a combined loss, depending on the alternative, of up to about 0.1 acre (0.04 hectare) of marine vegetation, and conversion of up to 0.14 acre (0.056 hectare) of nearshore habitat and up to 0.045 acre (0.018 hectare) of offshore soft-bottom habitat to hard substrate. Benthic habitats outside of the long-term project footprints would reestablish after construction, whereas those in the relatively small footprints noted would be permanently lost as habitats that support salmonid foraging and refuge.

The maximum number of in-water pile driving days required for construction of the LWI and SPE projects combined would be up to 285 (up to 80 days for LWI and up to 205 days for SPE), with up to two in-water work seasons required for each project, for a total of four in-water work seasons under current schedules. Construction of the two projects would not overlap; therefore, concurrent or overlapping noise impacts would not occur. Once construction is completed, underwater noise during operations would return to levels similar to existing conditions.

The maximum combined coverage of overwater structures for combinations of the LWI and SPE alternatives would be 2 acres (0.8 hectare). However, all of the overwater coverage that would occur in the nearshore migratory pathway for these two projects would be associated with LWI Alternative 2.

The intertidal and shallow subtidal piles and mesh of LWI Alternative 2 may create a migration barrier to nearshore-migrating salmonids, resulting in a potential increase in predation risk. The combined maximum number of in-water permanent piles required for the LWI and SPE alternatives would be up to 810, depending on the alternative. However, although more piles could occur for the SPE alternative (up to 660) than LWI (up to 150), the offshore location of the SPE piles would not substantially increase the potential nearshore migration barrier effect represented by the intertidal and shallow subtidal LWI in-water structures alone.

#### 3.3.2.4.2. OTHER MARINE FISH SPECIES

Combined impacts on other marine fish species from the construction and operation of the LWI and SPE projects would be similar to those described above for salmonids (Section 3.3.2.4.1). The in-water portions would result in direct habitat conversion from soft-bottom benthic habitats, to hard substrate (Section 3.3.2.4.1). These habitat impacts could reduce the amount of foraging and refuge habitats for some species, including shiner perch, gunnels and forage fish. However, some fish species prefer more structured habitats (e.g., pile perch, greenling, juvenile rockfish, and cabezon) and may benefit from in-water structures. Nearshore migrating forage fish may experience a similar potential barrier effect from LWI Alternative 2 (as described above for salmonids), but most are expected to be able to swim through the mesh. There is potential for them to delay or alter their migration, but these impacts would be highly localized the mesh itself.